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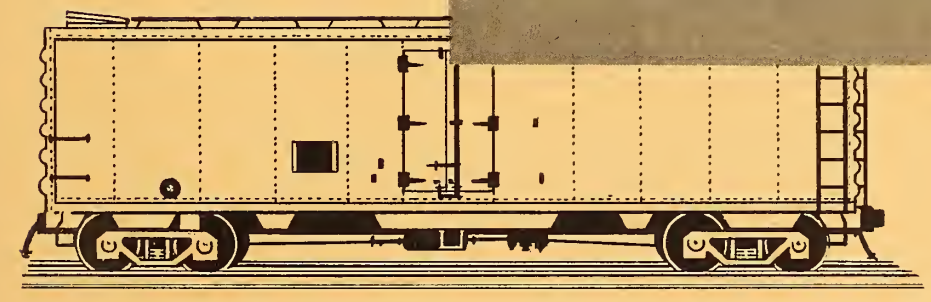
Transportation Tests

of Fresh Meat and Packinghouse Products in Refrigerator Cars

(An interim report)



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This study was conducted under authority of the Agricultural Marketing Act of 1946 (RMA, Title II).

SUMMARY

This report is based on one of a series of studies to determine more efficient and economical methods of protecting meat and packinghouse products while in transit by railroad and motortruck during the different seasons of the year. Six tests were made of railroad transportation refrigeration, involving 20 carloads of these products and using various icing services in combination with precooling of the empty cars prior to loading. The different types of icing services used water ice, water ice with various percentages of salt added, water ice plus salt and dry ice, and water ice plus salt in fan cars.

Temperatures were reduced more in cars in which 15 percent salt was added to the bunker ice than in similar cars with 10 percent salt. But the tests showed that when the product was well chilled at the time of loading, 10 percent salt was sufficient to maintain adequate transit temperature, even in fairly warm weather, with considerable savings in refrigeration costs. However, in hot weather, the use of 15 percent salt might be justified by the greater protection it provides.

During the warm weather the lowest and most uniform temperatures were maintained in the car equipped with air-circulating fans. Temperatures of the product in this car were reduced 10.2° at the top of the load and 12.8° at the bottom, although the ice consumption, and consequently the cost, of refrigeration was greater in this car than in cars without fans in which water ice and salt were used. However, temperatures of the product in this car at destination averaged 26.3° at the top of the load and 22.5° at the bottom, which suggests that adequate temperatures might still have been maintained with a smaller percentage of salt than was used in the test. The industry generally tries to keep meat at temperatures of 35° to 40° F.

Cars cooled with water ice plus salt generally maintained products at the temperatures at which they were loaded or reduced temperatures in transit, although not as much as in the fan car. Greater uniformity in temperatures was maintained also during the warm weather in the fan car than in those not equipped with air-circulating fans. The spread between high and low product temperatures in the fan car upon arrival at destination was only 5.0°, while the average spread in 15 cars without fans was 14.0°.

When varying amounts of dry ice were used to supplement the water ice and salt in non-fan cars, the results in these tests did not appear to warrant the additional cost of the dry ice.

The limited consumption of ice in a number of the test cars that moved under full bunker ice during the late fall and winter months suggests that adequate temperatures might have been obtained by using half-stage icing, with consequent savings in refrigeration costs. Studies of the practicability and economy of this service in transit refrigeration of meat products should be made. Half-stage icing has been used in the transportation of a number of fresh fruits and vegetables during the cool months.

TRANSPORTATION TESTS OF FRESH MEAT AND PACKINGHOUSE PRODUCTS IN REFRIGERATOR CARS
(AN INTERIM REPORT)

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INTRODUCTION

This study of the temperatures of fresh meat and packinghouse products in refrigerator cars in current service, was made as a basis for determining improvements that might be made in present methods of handling, transporting, and protecting these products in transit. The conditions prescribed for refrigeration of carloads of meat products in transit vary widely among different meat-packing companies. It is the general practice, however, to try to hold meat products between 35° and 40° F.

Fresh meat and packinghouse products are generally shipped in refrigerator cars owned by the meat packers or leased to them by the private refrigerator carlines. Two general types of refrigerator cars are used: (1) The brine tank car has 4 metal tanks in each end of the car that are filled with crushed ice and cold brine; these tanks have a capacity of 4,500 to 7,500 pounds of crushed ice and salt brine. Refrigeration is obtained from the metal surface of the tanks. (2) The basket bunker car is very much the same as the standard refrigerator car used in the transportation of fresh fruits and vegetables, except that it is equipped with meat rails. The basket bunker cars have a capacity of 5,000 to 11,600 pounds of crushed ice. Recently, a few refrigerator cars equipped with mechanical systems of refrigeration have been used in the movement of meat products.

The tests described in this report deal only with the basket bunker cars. Tests on the brine tank cars and mechanical refrigerator cars are planned for the future.

During 1951 and 1952, 6 transportation tests were conducted--4 from Madison, Wis., and 2 from Austin, Minn.

EQUIPMENT

In each of 4 tests (tests I, II, IV, and V), refrigerator cars of the same series and construction were selected in order to minimize any possible differences in tightness and insulation. These cars were of the type commonly used, were in average repair, and had from 4 to 6 inches of insulation in the floors, roofs, and walls.

The 3 cars used in test I (cars A, B and C) were equipped with divided basket bunkers having a 4-inch flue in the center from the bottom to the

top of the bunkers intended to increase the circulation of air and improve refrigerating efficiency. The bunkers had a total capacity of 8,000 pounds of crushed ice. Inside dimensions of the cars were: length 30 feet 6 inches, width 8 feet 3 inches, and height 6 feet 8 inches.

Cars D, E, F and G in test II were standard refrigerator cars similar to those used in test I except that the bunkers did not have the center flues. Inside dimensions were: length 33 feet 2 inches, width 8 feet 1 inch, and height 6 feet 4 inches. The total capacity of the bunkers was 11,600 pounds of crushed ice. The general outline of the type of car used in tests I and II may be seen in figure 1.

Four standard refrigerator cars were used in test III, but they were not all of the same series. Car H was 32 feet 9 inches long, 8 feet 4 inches wide, and 6 feet 6 inches high on the inside and had a total bunker capacity of 10,600 pounds. Car I had inside dimensions of 30 feet in length, 8 feet 3½ inches in width, and 6 feet 3-1/8 inches in height, with a bunker capacity of 9,500 pounds of crushed ice. The bunker capacity of car J was 7,200 pounds, and inside dimensions were length 30 feet 5½ inches, width 8 feet 3-5/8 inches, and height 6 feet 1½ inches. Car K measured inside 30 feet long, 8 feet 4½ inches wide, and 6 feet 3 inches high, and its bunker capacity was 9,900 pounds of crushed ice. In this test the cars were varied to determine whether the quantities of ice used in the bunkers had any significant bearing upon the temperatures maintained and the amounts of ice consumed during the cooler months of the year when this test was made.

Three cars were used in test IV (cars L, M, and N), which were of the same series as those used in test II, and therefore had the same dimensions and bunker capacity.

Test V had 3 cars of one series (cars O, Q, and R 1/), identical to car I in test III.

In test VI, 2 of the cars used (cars S and T) were of the same series as those used in test I. The third car (U) was equipped with air-circulating fans driven by a pulley arrangement actuated by the wheel of the car when in motion. For initial cooling of the load before the car was in motion, an auxiliary electric motor was attached to a bracket on the underframe of the car and connected by a belt to the drive shaft of the fans. The fans were located under the floor racks about 2 feet from the bunker opening at each end of the car. A metal housing around the fans directed the air toward the ice bunker regardless of the direction in which the fans rotated. The bunkers had a capacity of 11,000 pounds of crushed ice. Inside dimensions of the car were: length 33 feet 2 inches, width 8 feet 3 inches, and height 7 feet 6 inches. The type of car is illustrated in figure 2.

1/ The omission of car P is explained on p. 19.

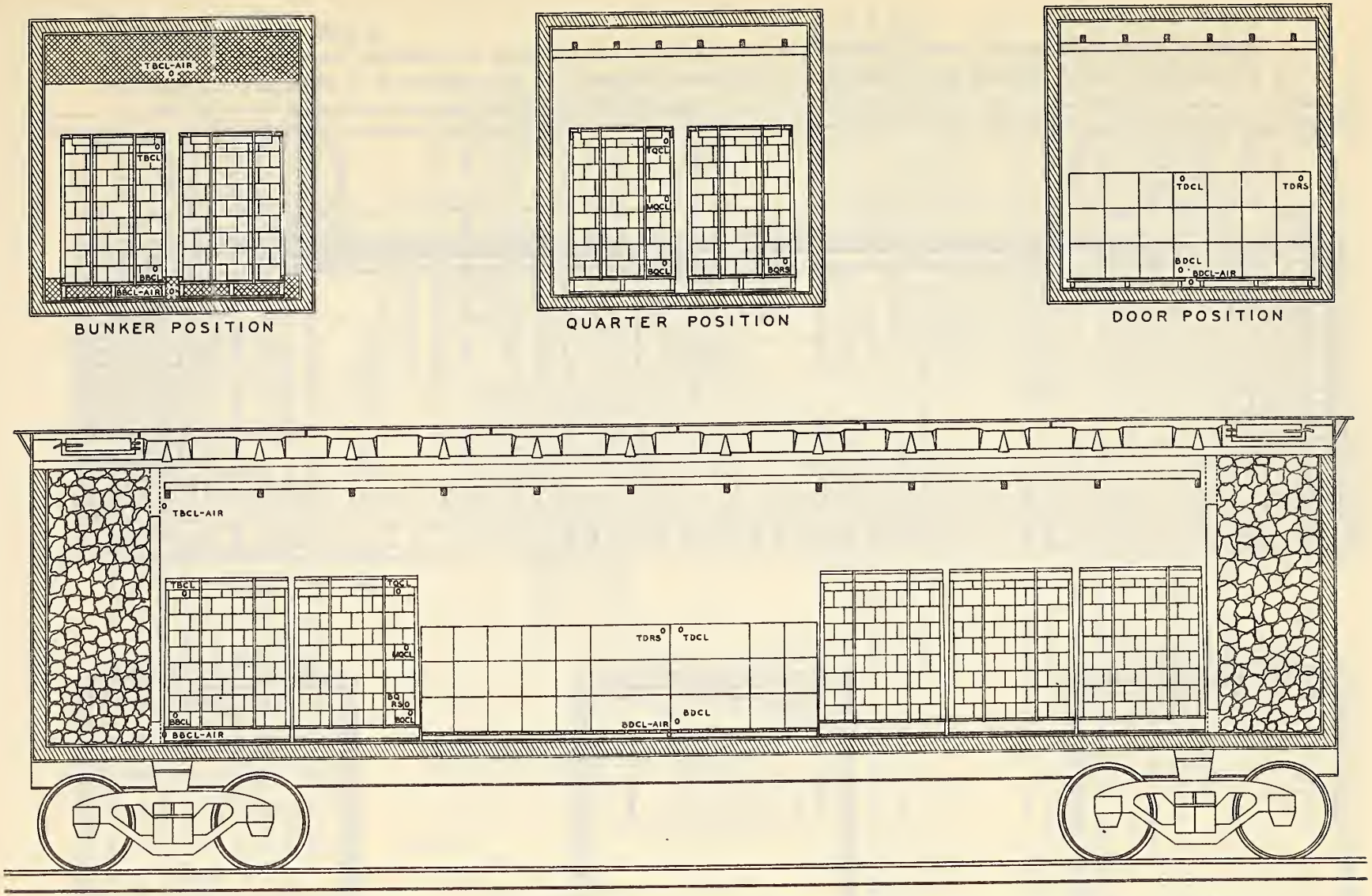


Figure 1.--A diagram of a refrigerator car showing the method of loading the product on pallets and on temporary floor racks and also the locations of the electric resistance thermometers. For explanation of TBCL, BBCL, etc., see page 5.

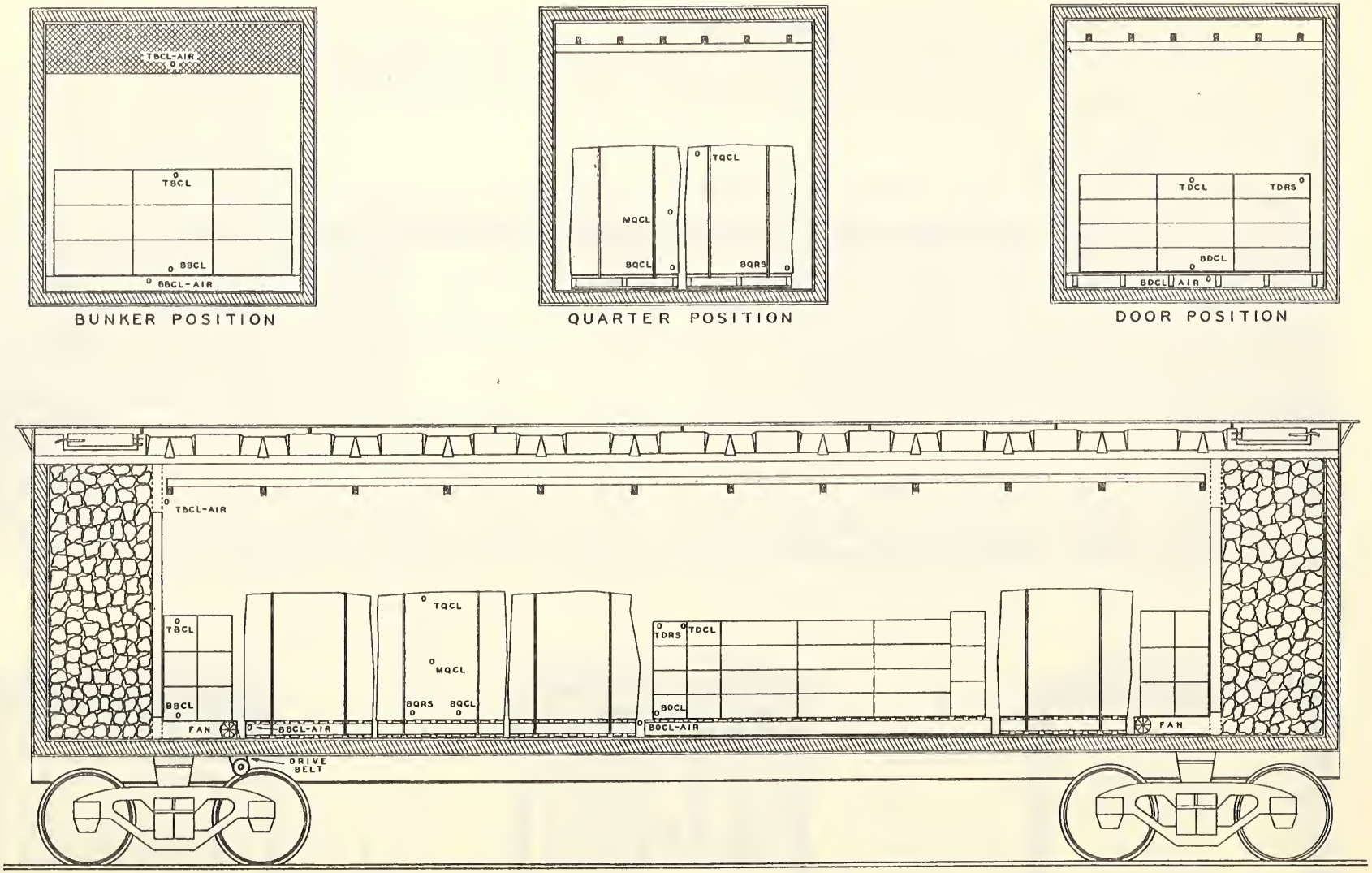


Figure 2.--A diagram of a refrigerator car showing the method of loading in the fan car and the location of the electric resistance thermometers during a test on meat and packinghouse products. For explanation of TBCL, BBCL, etc., see page 5.

TEST PROCEDURE

Air and product temperatures inside the cars were measured by means of electric-resistance thermometers. The thermometer bulbs were connected through leads to a master cable that extended outside through a flexible door plate. Temperature readings were made by connecting a multiple plug on the master cable to a special temperature reading instrument. In all instances, commodity temperatures were obtained by inserting the thermometer bulb directly into the products. In placing the electrical-resistance thermometer bulbs on the side of the containers along the side walls, the bottom row was used for the floor positions, and the top row of containers was used at the top of the load. The three resistance thermometer bulbs used to obtain air temperatures were placed in the designated positions in such a way that they were not in contact with the load or the structure of the car.

Temperatures were taken in one end of each of the test cars as previous tests have shown that both ends of the cars are similarly refrigerated. Air and product temperatures were recorded every 4 to 6 hours while the cars were in transit. A set of 12 electric-resistance thermometers was used in each of the test cars. The locations of the thermometer bulbs were the same in all the tests, and were designated as follows:

Location	Designation
Bottom bunker centerline - commodity	BBCL
Bottom bunker centerline - air	BBCL - air
Top bunker centerline - air	TBCL - air
Top bunker centerline - commodity	TBCL
Bottom quarterlength centerline - commodity	BQCL
Bottom quarterlength rightside - commodity	BQRS
Top quarterlength centerline - commodity	TQCL
Middle quarterlength centerline - commodity	MQCL
Top door right side - commodity	TDRS
Top door centerline - commodity	TDCL
Bottom door centerline - commodity	BDCL
Bottom door centerline - air	BDCL - air

CLEANING AND CAR ICING

Refrigerator cars used in the transportation of fresh meat and packinghouse products are generally kept in constant service. When they are unloaded, they are immediately returned empty to the owner or the lessee. Upon arrival at the plant, the car doors are opened and the floor racks raised and hooked to the walls. The cars are then thoroughly cleaned with live steam and hot water. After several hours of drying, the cars at one plant were switched to the loading platform where the bunkers were filled to capacity with briquette ice (approximately 1 pound pieces). The ice was moved from a chute in large buckets, which have a

capacity of about 500 pounds, by an overhead conveyor to the cars where the ice was dumped into the bunker (fig. 3). This operation usually took from 5 to 6 minutes per car. After the bunkers were iced to capacity at about 6:00 p.m., the cars were allowed to cool during the night to be ready for loading early the following morning. During the time of precooling, no salt was added to the bunker ice. The general practice was to add the salt in the bunker the following day while the cars were being loaded or at the first regular icing station in transit.

At another plant, the icing operation was somewhat different. After the cars were cleaned in much the same manner as at the first plant, a switch engine, coupled to a string of about 10 cars, moved the first car directly under the ice chute. After the bunkers of that car were filled to capacity, the engine moved the next car to the ice chute until all the cars were iced. At this plant, the cars were generally iced at about 9:30 in the morning and were allowed to cool until the next morning. No salt was added to the ice during the initial icing.

Figure 3.--Illustration of the method of icing the bunkers of refrigerator cars.

PRECOOLING

In shipping fresh meats and packinghouse products it is customary to ice the bunkers of the refrigerator car to capacity the day before loading. The purpose of this cooling is to prevent the product from sweating and to minimize the danger of subsequent deterioration. Most shippers reduce the car temperature to or below the temperature of the product being loaded.

To determine the rate and degree of precooling, air temperatures inside the cars were measured by means of the electric-resistance thermometers previously mentioned. Six of the thermometer bulbs were suspended from the meat rails 7 inches above the floor racks, and 6 thermometer bulbs were placed 8 inches below the ceiling at various locations in one end of the car.

In some of the test cars varying amounts of ice remained in the bunkers from previous trips and these quantities have been shown in each case. In making the comparisons of refrigerating efficiency and figuring the cost of providing the service 2/, the charges shown have been based upon the full amount of ice contained in the bunkers at the time the cars were loaded, including the value of any ice remaining from a previous trip.

TYPES OF LOADS AND PACKAGES

In shipping fresh meat and packinghouse products in mixed cars, the general practice is to load products such as fresh pork loins, boiled hams, slab bacon, pork trimmings, frozen livers, and many other meats in the same car. Therefore, no standard method of loading, such as in straight carloads of fresh fruits and vegetables in standard packages, was used, except in cars A, D, F, and G, which were straight carloads.

In a few cases, the equivalent of a straight carload was obtained in that the load consisted of no more than two types of product and of packages whose temperature requirements were very nearly identical. Figures 4 and 5 illustrate this type of load.

In another method of loading, quarters of beef were hung in each end of the car and lamb and veal carcasses were hung in the doorway. This entire load was suspended from the meat rails in the car. In some instances, canned goods at a temperature of 65° F. were loaded in the same cars as fresh meat at a temperature of 40° to 45°. Cars shipped on orders to be distributed at destination have a mixture of containers of all sizes, from large cartons of cooked hams to small packages of sausage. These containers are stacked in the cars tightly from end to end (fig. 6).

2/ Based upon information obtained from one shipper, an estimated cost of $5 per ton for ice and $1 per 100 pounds of salt was used in arriving at the costs of furnishing refrigeration at the shipping point. The charges for ice, salt, and switching for re-icing in transit were based on the charges as published in section 4 of the National Perishable Protective Tariff. The charge for dry ice was 4 cents per pound delivered at the packing plant.

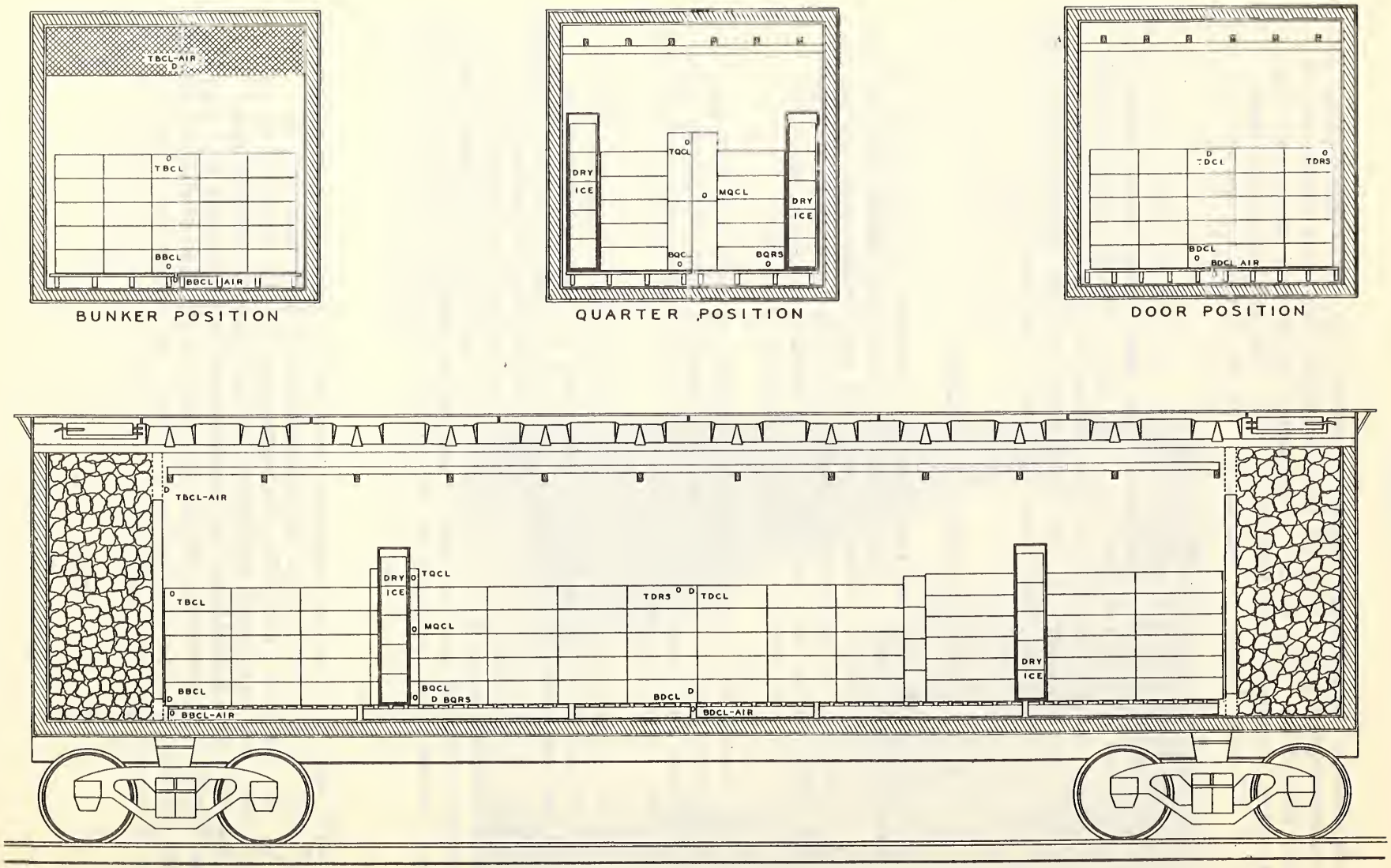
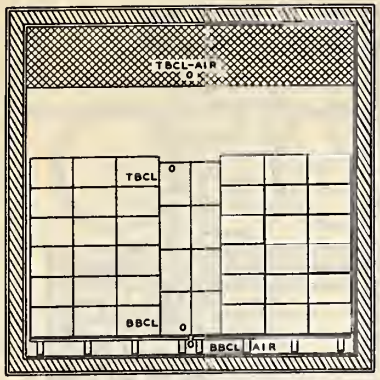
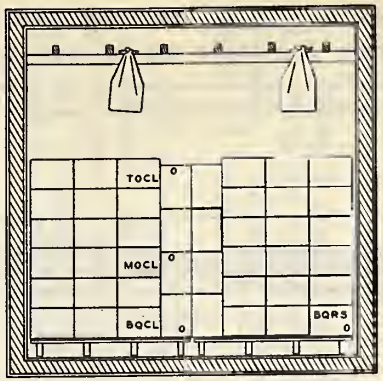


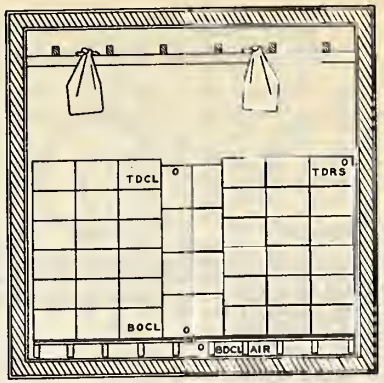
Figure 4.--A diagram of a refrigerator car showing the method of loading the different types of packages, the location of the portable dry ice bunkers and the location of the electric resistance thermometers. For explanation of TBCL, BBCL, etc., see page 5.



BUNKER POSITION



QUARTER POSITION



DOOR POSITION

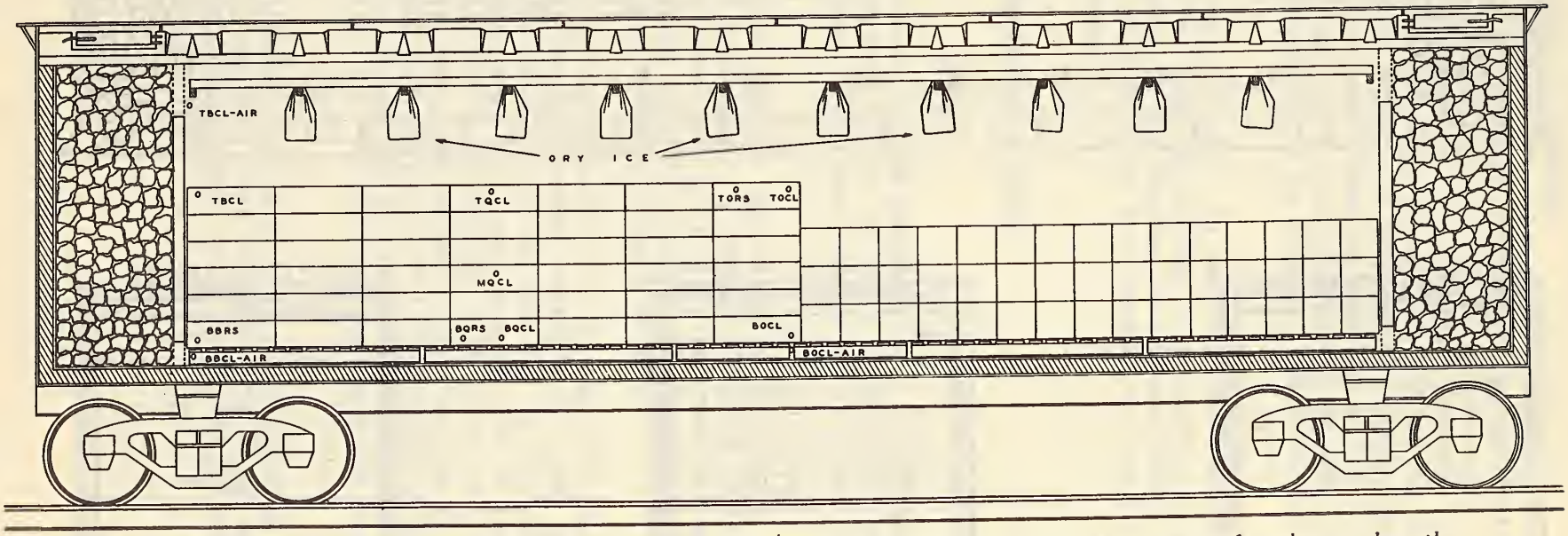


Figure 5.--A diagram of a refrigerator car showing the method of loading the different types of packages, how the dry ice was suspended from the meat rails, and the location of the electric resistance thermometers. For explanation of TBCL, BBCL, etc., see page 5.

FIG #5

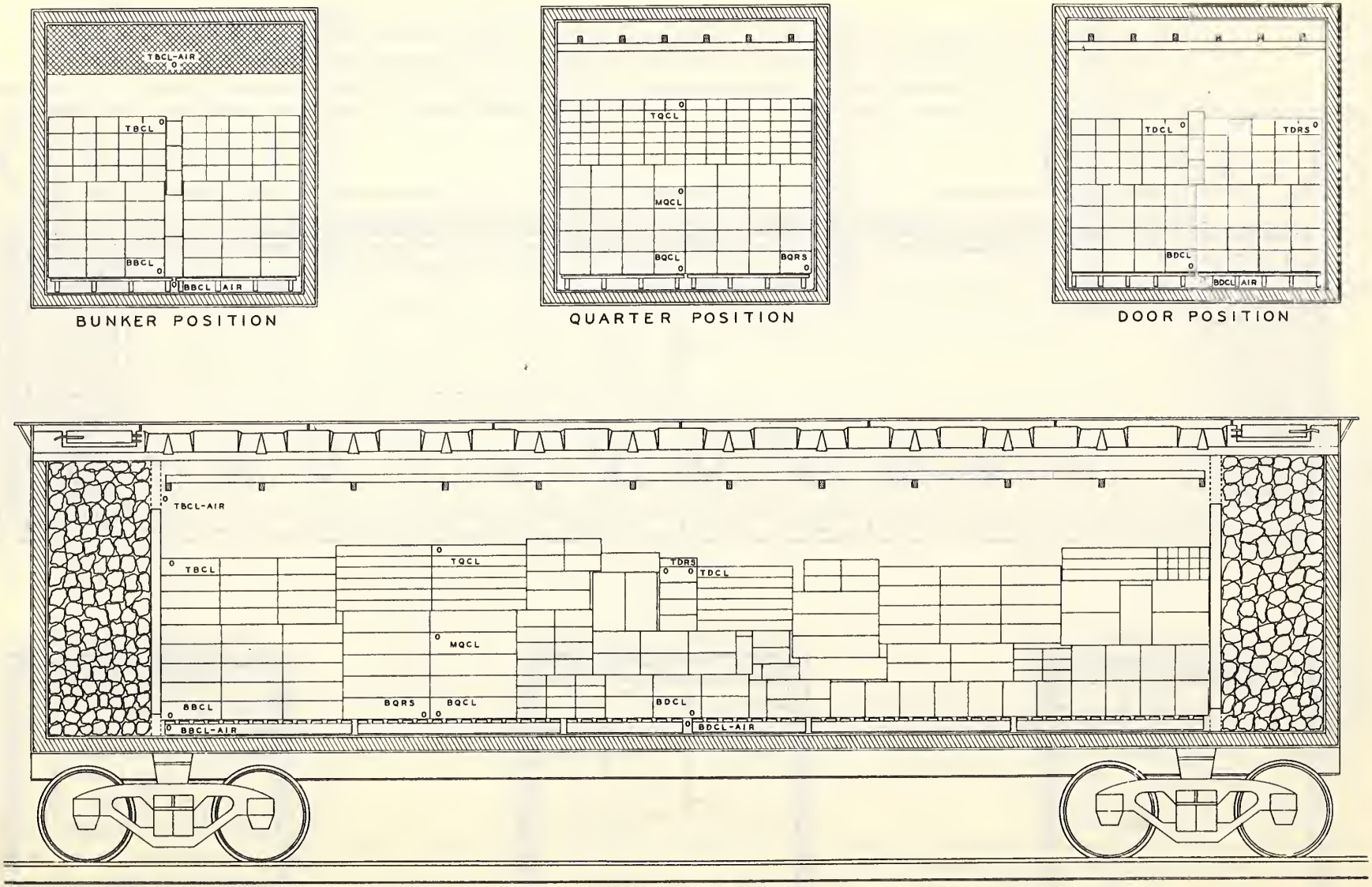


Figure 6.--A diagram of a refrigerator car showing the method of loading order cars illustrating the great variety and sizes of packages; also the location of the electric-resistance thermometers. For explanation of TBCL, BBCL, etc., see page 5.

METHODS OF LOADING

At both plants the products were brought directly from the cooling rooms to the loading platform on pallets carried on forklift trucks. At the car door the pallets were deposited on the platform where they were again picked up by a battery pallet transporter and moved into the car. In some cases the floor racks were raised and tilted back against the side of the car and the pallet and load deposited together on the floor. In other cases, the packages of meat were removed from the pallets and stacked on the floor racks. Sometimes, as in figure 1, both methods were used in the same car.

At the Austin plant, four cars—J and K in test III and P and Q in test car V—were switched directly into the cooling room inside the building. Various products were stored in the cooling room where orders were assembled and placed on a long conveyor belt that carried the orders directly into the cars for loading.

TRANSPORTATION TESTS

Test I

Test I consisted of 3 cars moving from Madison, Wis., to Philadelphia, Pa. Outside temperatures ranged from 52° F. to 83° F. during the time in transit. General information about these cars, including routing, are shown in table 1.

Car A consisted of a straight load of slab bacon in fiberboard containers; car B carried mixed pork loins in wooden wirebound crates, and boiled hams, Canadian bacon, and slab bacon, all in fiberboard cartons; and car C consisted mostly of fresh pork trimmings in fiberboard cartons, wieners in fiberboard cartons, and a barrel of pork livers.

The 3 cars were initially iced to capacity late in the afternoon of August 22, 1951, each car having the same bunker capacity of 8,000 pounds. The cars were replenished with crushed ice during loading the following afternoon. For purposes of comparison, car A was shipped with 10 percent salt and re-iced once in transit; car B was shipped with 15 percent salt and re-iced twice in transit; and car C had no salt placed on top of the ice in the bunkers, but, instead, was charged with 1,152 pounds of dry ice placed in 4 portable bunkers located at the quarterlength by the side walls in each end of the car (fig. 4). No re-icing was furnished car C in transit.

While the cars were being loaded at 11 a.m., car A was supplied with 800 pounds of salt (10 percent), and car B was supplied with 1,200 pounds of salt (15 percent). After car C was loaded, the dry ice was placed in the portable bunkers.

Table 1.--General information relative to 3 refrigerator cars used in shipping meats, test I, Madison, Wis., to Philadelphia, Pa., August 23-26, 1951 1/

Item	Test car-- A	B	C
Car number	URT 5387	URT 5383	URT 5324
Type of car	RSM 2/	RSM 2/	RSM 2/
Method of refrigeration	Ice plus 10% salt 1 re-ice	Ice plus 15% salt 2 re-icings	Ice plus dry ice
Routing	C&NW-IHB-PRR	C&NW-IHB-PRR	C&NW-IHB-PRR
Date loaded	8-23-51	8-23-51	8-23-51
Date unloaded	8-26-51	8-26-51	8-26-51
Time in transit	69 1/4 hours	68 3/4 hours	67 1/2 hours
Gross weight of product	32,500 lbs.	31,000 lbs.	28,500 lbs.
Product temperature at loading:			
Range	34° to 27° F.	42° to 30° F.	42° to 26° F.
Average 3/	30.1° F.	34.7° F.	30.8° F.
Product temperature at unloading:			
Range	36° to 22° F.	38° to 26° F.	35° to 29° F.
Average 3/	29.6° F.	32.3° F.	30.6° F.

1/ Outside temperatures, range 52.0° to 83.0° F.
2/ Refrigerator car equipped with basket bunkers and meat rails.
3/ The average temperatures include all positions both top and bottom of the load.

Loading in car A was started at 7 a.m. and completed at 4:15 p.m.; car B also was started at 7 a.m. and completed at 3:30 p.m.; and in car C loading was started at 2:30 p.m. and completed at 5:15 p.m. During loading, all of the cars were protected by a split canvas curtain at the doorway to retain the effects of the precooling.

In car A the product temperature taken at the packing plant averaged 29.3° F. at the top of the load and 31.3° at the bottom. At destination, the temperature at the top of the load averaged 30.5° and at the bottom 29°. The maximum and the minimum product temperatures showed a spread of 10° with very little fluctuation during transit.

For car B average product temperature at the top remained very steady at 35° and the average bottom product temperature was reduced from 33.5° to 28.8° during transit. The difference between the average temperatures at the top and bottom of the load at destination was 6.2°. The maximum and minimum temperatures at the top of the load showed a spread of 5° with some slight fluctuation in transit; however, the maximum and minimum temperatures of the product at the bottom of the load remained very close throughout the transit periods.

In car C the average product temperatures at the top and bottom remained within 1° throughout the time in transit between 29° and 31°. The maximum and minimum temperatures at the top of the load remained fairly constant close to 30°. The bottom maximum temperature was lowered from 42° to 34° and from then on remained fairly steady. The minimum temperature showed a rise of 3° from origin to destination.

The charges for providing each type of protective service were as follows: Car A, $39.10; car B, $55.75; and car C, $68.33.

The average temperatures for these 3 cars are shown in tables 8, 9, and 10 and figures 7 through 9 in the Appendix.

Test II

Test II consisted of 4 carloads of fresh meat and packinghouse products, also shipped from Madison, Wis., to Philadelphia, Pa., in September 1951. Outside temperatures ranged from 54° to 78° F. during the transit period. Information concerning the test and average temperatures found are shown in table 2.

Car D was a straight load of derined bacon for slicing, packed in fiberboard cartons. Car E was a mixed load, consisting of pork loins in wooden wirebound crates, sliced bacon, Canadian bacon packed in fiberboard cartons, and frozen pork hearts, pork trimmings, liver, neck bones, and shank trimmings.

Car F was a straight load of pork loins; car G was a straight load of frozen pork trimmings.

The 4 cars were initially iced to capacity late in the afternoon of September 24. Each car had a capacity in the bunkers of 11,600 pounds of crushed ice; however, car D had 300 pounds of ice remaining in the bunkers, so it was filled with 11,300 pounds. The bunkers were replenished to capacity late the following afternoon.

In this test, comparisons were made by shipping 2 cars with 10 percent salt added and 2 cars with 15 percent salt added. All 4 cars were re-iced once in transit. Loading of car D started at 8:40 a.m. and was completed at 12:01 p.m. Loading of car E started at 8:25 a.m. and was completed at 3 p.m. Loading of car F started at 8:20 a.m. and was completed at 11 a.m. Loading of car G started at 1 p.m. and was completed at 3:55 p.m.

In car D, the average product temperatures both at the top and bottom of the load averaged 29.8° F. when loaded. During the transit period the average product temperature at the top of the load showed a gradual rise to 32.5° and the bottom average was reduced from 29.8° to 25.5° with a spread of 7° between the averages.

Table 2.—General information relative to 4 refrigerator cars used in shipping meats, test II, Madison, Wis., to Philadelphia, Pa., September 25-28, 1951 1/

Item	Test car-- D	E	F	G
Car number	MERX 523	MERX 591	MERX 586	MERX 587
Type of car	RSM 2/	RSM 2/	RSM 2/	RSM 2/
Method of refrigeration	Ice plus 10% salt 1 re-ice	Ice plus 10% salt 1 re-ice	Ice plus 15% salt 1 re-ice	Ice plus 15% salt 1 re-ice
Routing	C&NW-IHB-PRR	C&NW-IHB-PRR	C&NW-IHB-PRR	C&NW-IHB-PRR
Date loaded	9-25-51	9-25-51	9-25-51	9-25-51
Date unloaded	9-28-51	9-28-51	9-28-51	9-28-51
Time in transit	69 1/4 hrs.	66 hrs.	68 1/4 hrs.	63 3/4 hrs.
Gross weight of product	33,000 lbs.	33,000 lbs.	36,000 lbs.	37,000 lbs.
Product temperature at loading:				
Range	32° to 28° F.	40° to 36° F.	41° to 37° F.	7° to -14° F.
Average 3/	29.6° F.	37.7° F.	39.7° F.	-4.8° F.
Product temperature at unloading:				
Range	35° to 14° F.	38° to 21° F.	40° to 26° F.	15° to 0° F.
Average 3/	28.6° F.	32.9° F.	33.2° F.	9.3° F.

1/ Outside temperatures, range 54.0° to 78.0° F.
2/ Refrigerator car equipped with basket bunkers and meat rails.
3/ The average temperatures include all positions both top and bottom of the load.

The top maximum and minimum product temperature showed a gradual rise within a spread of 5°. The bottom maximum remained steady for the first half of the trip and then showed a gradual rise; however, the bottom minimum dropped very sharply and then remained fairly steady. The bottom bunker centerline position, which is generally the coldest spot, dropped from 29° to 14°. At destination, the spread between maximum and minimum temperatures at the bottom of the load was 21°.

In car E, the average product temperature taken after loading was completed averaged 37.8° at the top of the load and 38° at the bottom. At destination the top average product temperature was reduced gradually to 35.5° and the bottom average to 29.3°. The top maximum temperature was reduced 2° and the minimum 3° within a 5° spread. The bottom maximum temperature was reduced 4° and the minimum was reduced from 37° to 21° with a spread at destination of 15°.

In Car F, the average product temperature at the top of the load at origin was 40.5° and at the bottom 38.8°. At destination the top average had been reduced to 38.8° and the bottom to 27.8°. The maximum and minimum product temperatures at the top of the load were reduced gradually until the third afternoon when there was a slight rise. At the bottom of the load the maximum temperature was reduced from 41° to 30° with a rise of 4° on the third afternoon after which it dropped again. The minimum reading dropped rapidly about 10° during the first 24 hours and then remained fairly constant throughout the remainder of the trip. At destination the spread between maximum and minimum was only 4°.

Car G was a straight load of frozen pork trimmings. When loaded, the average product temperature in the top of the load was -1.5° F. and -8.0° in the bottom. There was a gradual rise during the test. At destination the top average was 13° and the bottom was 6.5°. It is the usual practice to have this frozen product warm up slowly in transit so that it can be ground into manufactured products more readily.

It was contemplated that the test would consist of 4 cars of fresh products, but a sufficient volume moving to the same destination was not available on that day. Consequently, the load of frozen pork trimmings was included for observation of the behavior in transit of a commodity below zero temperature at the time of loading when water ice and 15 percent salt were used.

There was little difference in the average temperatures maintained in the 3 cars containing fresh products (cars D, E and F). They were all within a range of 6.3° at the top of the load and 3.8° at the bottom.

The charges for providing each type of protective service were as follows: Car D, $59.42; car E, $53.23; car F, $65.67; and car G, $62.26.

The average temperatures for these 4 cars are shown in tables 11 through 14 and figures 10 through 13 in the Appendix.

Test III

Test III was conducted from Austin, Minn., to Newark, N. J., to learn the amount of ice consumed on shipments during the late fall season when outside temperatures ranged from 16° to 46° F. Routing and other general information are shown in table 3. This test included 4 carloads of fresh and frozen meat and packinghouse products, which were loaded on orders by lot numbers in miscellaneous-size packages for delivery at destination to various retail stores. The 4 cars were initially iced to capacity at 9:45 a.m. on October 26, 1951, and no salt was added to the bunker ice. The bunker capacities ranged from 7,200 pounds to 10,600 pounds; no 2 cars had the same capacity. The cars were shipped with initial ice only; with no replenishment at origin or in transit.

Table 3.--General information relative to 4 refrigerator cars used in shipping meats, test III, Austin, Minn., to Newark, N. J., November 1-5, 1951 1/

Item	Test car-- H	I	J	K
Car number	NADX 3636	NADX 13005	NADX 703	NADX 13551
Type of car	RSM 2/	RSM 2/	RSM 2/	RSM 2/
Method of refrigeration	Initial ice only	Initial ice only	Initial ice only	Initial ice only
Routing	CMStP&P-IHB-NKP-LV	CMStP&P-IHB-NKP-LV	CMStP&P IHB-NKP-LV	CMStP&P-IHB-NKP-LV
Date loaded	11-1-51	11-1-51	11-1-51	11-1-51
Date unloaded	11-5-51	11-5-51	11-5-51	11-5-51
Time in transit	82 3/4 hrs.	86 1/4 hrs.	80 hrs.	79 1/2 hrs.
Gross weight of product	31,433 lbs.	30,352 lbs.	31,047 lbs.	34,547 lbs.
Product temperature at loading:				
Range	42° to 32° F.	44° to 17° F.	37° to 30° F.	40° to 25° F.
Average 3/	36.0° F.	35.3° F.	33.3° F.	34.1° F.
Product temperature at unloading:				
Range	35° to 30° F.	33° to 25° F.	33° to 29° F.	37° to 30° F.
Average 3/	32.4° F.	30.6° F.	31.8° F.	32.4° F.

1/ Outside temperatures, range 16.0° to 46.0° F.
2/ Refrigerator car equipped with basket bunkers and meat rails.
3/ The average temperatures include all positions both top and bottom of the load.

Car H had approximately 8,000 pounds of ice remaining in the bunkers from a previous trip and only 2,600 pounds were needed to fill the bunkers to capacity. Car I was filled to capacity with 9,500 pounds of fresh ice. Car J had 2,400 pounds remaining and was filled to capacity with an additional 4,800 pounds. Car K had 2,500 pounds of ice remaining and was filled to capacity with 7,400 pounds of fresh ice. Each of the shipments contained both frozen and non-frozen boxed meats, plus hanging beef quarters and lamb or veal carcasses in the doorway. Loading of cars H and I started at 11:30 a.m. and was completed at 2:20 p.m. and 2:10 p.m., respectively. These 2 cars were loaded at a loading platform through heavy canvas tunnels. Cars J and K were switched inside one of the buildings where they were loaded in one of the cooling rooms. Loading of car J was started at 1:30 p.m. and completed at 2:55 p.m., and car K was started at 10:30 a.m. and completed at 2:40 p.m.

In car H the average top and bottom product temperatures were gradually reduced during the time in transit. The top maximum temperature was reduced from 42° to 35° F. in approximately the first 15 hours and remained steady for the remainder of the test. The maximum and minimum of the bottom of the load were reduced gradually until a few hours before the doors were opened for unloading.

In car I the top average product temperature was reduced gradually from 44° at origin to 33° at destination. The bottom average remained fairly steady throughout the test with very little fluctuation.

In car J the maximum and minimum and average product temperatures remained very close during the test. It should be pointed out that the range of product temperatures when loading was completed was narrow. The temperatures remained almost steady during the test.

In car K the average product temperature at the top of the load was reduced from 35.5° F. at origin to 33.8° at destination and the average bottom temperature was reduced from 32.3° to 31°. The maximum temperature at the top of the load was reduced from 40° to 37° and the minimum showed a rise from 27° to 30°. At the bottom of the load the maximum was reduced from 38° to 32° and the minimum showed a rise from 25° to 30°. The narrow spread in the product temperature between the top and bottom of the loads of the 4 cars shown in table 3 is attributed to the relatively cold outside temperatures encountered during the test.

The costs of providing the icing service were as follows: Car H, $26.50; car I, $23.75; car J, $18; and car K, $24.75. No two of the 4 cars had the same ice bunker capacity which accounts for the differences in the cost of the ice.

The average temperatures for these 4 cars are shown in tables 15 through 18 and figures 14 through 17 in the Appendix.

Test IV

Test IV included 3 carloads of fresh meat and packinghouse products shipped from Madison, Wis., to Philadelphia, Pa., on May 19, 1952. Outside temperatures during this test ranged from 48° F. to 78°. General information with respect to this test is shown in table 4.

As in previous tests, the 3 test cars were initially iced to capacity late in the afternoon of the day before loading. No salt was placed in the bunkers at that time. The bunkers in car L had 2,900 pounds of ice remaining from a previous trip, and cars M and N contained 5,800 pounds each. The 3 cars had the same bunker capacity of 11,600 pounds of crushed ice. Salt was placed in the bunkers while the cars were being loaded.

For comparison purposes, car L was shipped under instruction "initial ice only plus 10 percent salt, do not re-ice in transit." Car M was shipped

"initial ice plus 10 percent salt, re-iced once in transit, plus 10 percent salt," and car N was shipped "initial ice plus 20 percent salt, re-ice once in transit plus 20 percent salt." Car L was loaded with smoked butts, skinned hams, sandwich spread, and liverwurst. Loading started at 11:45 a.m., May 20, 1952, and was completed at 3:10 p.m. Car M contained skinned hams, sandwich spread, and derined bacon. Loading started at 8:15 a.m. and was completed at 4 p.m. Car N held skinned hams and derined bacon; loading started at 8:15 a.m. and was completed at 2 p.m.

Table 4.--General information relative to 3 refrigerator cars used in shipping meats, test IV, Madison, Wis., to Philadelphia, Pa., May 20-23, 1952 1/

Item	Test car--		
	L	M	N
Car number	MERX 546	MERX 556	MERX 590
Type of car	RSM 2/	RSM 2/	RSM 2/
Method of refrigeration	Ice plus 10% salt	Ice plus 10% salt 1 re-ice	Ice plus 20% salt 1 re-ice
Routing	C&NW-IHB-PRR	C&NW-IHB-PRR	C&NW-IHB-PRR
Date loaded	5-20-52	5-20-52	5-20-52
Date unloaded	5-23-52	5-23-52	5-23-52
Time in transit	66 hrs.	63 1/4 hrs.	68 hrs.
Gross weight of product	32,000 lbs.	34,000 lbs.	32,000 lbs.
Product temperature at loading:			
Range	46° to 40° F.	57° to 41° F.	46° to 40° F.
Average 3/	42.6° F.	46.7° F.	42.7° F.
Product temperature at unloading:			
Range	50° to 34° F.	42° to 27° F.	50° to 23° F.
Average 3/	42.8° F.	36.4° F.	34.6° F.

1/ Outside temperatures, range 48.0° to 78.0° F.
2/ Refrigerator car equipped with basket bunkers and meat rails.
3/ The average temperatures include all positions both top and bottom of the load.

In car L the top average product temperature rose from 43.8° F. to 47° from origin to destination. The bottom average was reduced from 41° to 38.3°. The top maximum temperature, which rose from 46° at the first reading to 54° at the second, was reduced to 50° at destination with some slight fluctuation in transit. The minimum temperature showed a gradual rise from 41° to 45°. The maximum temperature at the bottom of the load showed a gradual rise of 2°, and the bottom minimum was lowered from 40° to 34°. The product temperatures in car L were too high; one re-icing in transit should have been made.

In car M the temperatures at all of the positions at the top and bottom of the load were reduced. The top average was reduced from 49.8° to 40.3°, and the bottom from 43.5° to 32° during transit. Maximum temperatures at the top of the load were reduced from 57° to 42°, the minimum was reduced from 44° to 37°. At the bottom of the load the maximum temperature was reduced from 45° to 36° and the minimum was reduced from 41° to 27°.

In car N, temperatures of all positions both top and bottom were reduced with the exception of the top door right side, which showed a rise of 9°, indicating that there evidently was an air leak in the door that allowed warm air to enter. The average product temperature at the top was reduced from 43.4° to 41.8°, and the bottom average was reduced from 41.8° to 27.5°.

The charges for providing each type of protective service were as follows: Car L, $39; car M, $48.85; and car N, $72.49.

The average temperatures for these 3 cars are shown in tables 19, 20 and 21 and figures 18 through 20 in the Appendix.

Test V

Test V, begun on July 10, 1952, from Austin, Minn., to Brooklyn, N. Y., included 4 carloads of fresh meats and packinghouse products. The outside temperatures during the transit test ranged from 72° F. to 95°. The routing and other general information are shown in table 5.

In an endeavor to determine the relative efficiency of mixing 10 percent salt with the ice at the time of shipment compared with addition of salt when the cars were re-iced in transit, 2 of the cars were charged with salt when they were initially iced and the other 2 cars did not receive salt in the bunkers until the first re-icing in transit. The 4 test cars were initially iced shortly after 2 p.m. on July 9, 1952. There wa no ice remaining in the bunker and all of the cars were filled to capacity with 9,500 pounds of fresh crushed ice.

In cars P and Q, 10 percent salt was added to the ice in the bunkers; cars O and R received no salt at origin. At 6:45 a.m. the following morning, prior to being set for loading, the 4 test cars were re-iced as follows: Car O, 1,500 pounds of crushed ice; car P, 2,000 pounds of crushed ice plus 200 pounds of salt; car Q, 2,000 pounds of crushed ice plus 200 pounds of salt; car R, 1,500 pounds of crushed ice. The 4 cars were billed to be re-iced to capacity plus 10 percent salt at Blue Island, Ill., Columbus, Ohio, and Huntingdon, Pa. Car O contained quarters of beef suspended from the meat rails in each end of the car, and at the doorway the load was filled with hanging lamb and veal carcasses. There were 25 cases of frozen liver on the floor under the hanging meat. Car P, which was billed out as a trailer car, was only partially loaded and no comparisons of refrigerating efficiency could be made. Car Q was loaded with fresh pork loins, pork butts, spareribs, and braunschweiger sausage. Car R was loaded with mixed products on order by lot numbers. Loading was

started in car O at 9:30 a.m. and was completed at 11 a.m.; in car Q at 9:20 a.m. and completed at 10:45 a.m.; and in car R at 10 a.m. and completed at 3:40 p.m.

Table 5.—General information relative to 3 refrigerator cars used in shipping meats, test V, Austin, Minn., to Brooklyn, N. Y., July 10-14, 1952 1/

Item	Test car—		
	O	Q	R
Car number	NADX 13037	NADX 13079	NADX 13061
Type of car	RSM 2/	RSM 2/	RSM 2/
Method of refrigeration	Salt added on re-icing only 3 re-icings	Ice plus 10% salt 3 re-icings	Salt added on re-icing only 3 re-icings
Routing	CMStP&P-IHB-PRR-LI	CMStP&P-IHB-PRR-LI	CMStP&P-IHB-PRR-LI
Date loaded	7-10-52	7-10-52	7-10-52
Date unloaded	7-13-52	7-13-52	7-13-52
Time in transit	88 1/2 hrs.	88 1/4 hrs.	82 1/4 hrs.
Gross weight of product	21,938 lbs.	30,328 lbs.	28,579 lbs.
Product temperature at loading:			
Range	45° to 38° F.	49° to 30° F.	50° to 17° F.
Average 3/	40.6° F.	38.3° F.	34.8° F.
Product temperature at unloading:			
Range	42° to 32° F.	42° to 29° F.	44° to 23° F.
Average 3/	36.4° F.	35.8° F.	33.3° F.

1/ Outside temperatures, range 72.0° to 95.0° F.
2/ Refrigerator car equipped with basket bunkers and meat rails.
3/ The average temperatures include all positions both top and bottom of the load.

In car O the average product temperatures of both the top and bottom of the load were reduced gradually during the test with very little fluctuation; there was a spread of 5.5° between the 2 averages. At destination the range of temperatures in positions at the top of the load was 6° and at the bottom 4°.

In car Q, the average temperature of the product at the top after loading was completed was 38.3°; it rose slightly until the evening of the second day of the test, and dropped slightly during the remainder of the trip. The bottom average temperature declined gradually from the time of loading until the end of the test. The spread in average temperatures between the top and bottom of the load was 7.5°. The range of temperatures in positions at the top of the load was 6° and at the bottom 7°.

In car R there was a wide range of temperatures in the mixed lot of meat and packinghouse products at the time of loading because of the inclusion of commodities that did not require low storage or transport temperatures. At the top the maximum was 50° and the minimum was 21°; at the bottom of the load the maximum was 49° and the minimum was 17°. The average product temperature at the top rose from 31.7° to 36° at 4 p.m. on the second day, probably due to the commodities loaded at the higher temperatures, after which it dropped during the balance of the trip. The average temperature at the bottom was reduced gradually from origin to destination.

The charges for providing each type of protective service were as follows: Car O, $44.79; car Q, $62.33; and car R, $40.52.

The average temperatures for these 3 cars are shown in tables 22, 23, and 24 and figures 21 through 23 in the Appendix.

Test VI

This test was made with 3 carloads of fresh meat and packinghouse products and was loaded on August 20, 1952, at Madison, Wis., and shipped to Philadelphia, Pa. The outside temperatures during the trip ranged from 59° to 82° F. The routing and other information concerning the test are shown in table 6.

The purpose of this test was to compare the efficiency of conventional bunker cars using crushed ice plus 15 percent salt supplemented by dry ice, with a fan-equipped car using crushed ice and 20 percent salt. Car S contained 600 pounds of dry ice suspended from the meat rails in cheesecloth, and car T had 1,200 pounds of dry ice suspended over the load in the same manner. Figure 5 shows how the dry ice was suspended. Car S was loaded with boxes of fresh pork loins and 6 large pallets of derined bacon, car T contained boxes of fresh pork loins and derined bacon, and car U had boxes of fresh pork loins and 8 pallets of derined bacon.

The pallets of derined bacon weighed approximately 2,100 pounds each. The pallets were 5½ inches high and 4 feet square, each covered with heavy fiberboard secured with metal straps. The floor racks were raised and the pallets set on the floor.

Of the 3 cars selected for this test, 2 were of the conventional type with meat rails and 1 was a standard refrigerator car equipped with forced air-circulating fans. The 3 cars were initially iced to capacity late in the afternoon of August 19, 1952. No salt was added to the bunker ice. Cars S and T had a bunker capacity of 8,000 pounds of crushed ice and car U held 11,000 pounds. Cars S and T were billed out with 15 percent salt added; car U was shipped with 20 percent salt. Car S started loading at 8:50 a.m. and was completed at 11 a.m., car T was started at 9:45 a.m. and was completed at 3:20 p.m.; and car U was started at 10:15 a.m. and was completed at 1:45 p.m. After the cars were loaded, the bunkers were supplied with salt and replenished to capacity with crushed ice. Car S received

1,500 pounds of salt and 300 pounds of crushed ice; car T, 1,500 pounds of salt and 100 pounds of crushed ice; and car U, 2,000 pounds of salt and 1,700 pounds of crushed ice. The dry ice was suspended in cars S and T after loading was completed and before the doors were closed and sealed.

Table 6.--General information relative to 3 refrigerator cars used in shipping meats, test VI, Madison, Wis., to Philadelphia, Pa., August 20-23, 1952 1/

Item	Test car-- S	T	U
Car number	URT 5885	URT 5428	WFE 69492
Type of car	RSM 2/	RSM 2/	Fan car 3/
Method of refrigeration	Ice plus 15% salt 2 re-icings and dry ice	Ice plus 15% salt 2 re-icings and dry ice	Ice plus 20% salt 2 re-icings
Routing	C&NW-IHB-PRR	C&NW-IHB-PRR	C&NW-IHB-PRR
Date loaded	8-20-52	8-20-52	8-20-52
Date unloaded	8-23-52	8-23-52	8-23-52
Time in transit	67 1/4 hrs.	65 hrs.	68 1/2 hrs.
Gross weight of product	25,000 lbs.	26,000 lbs.	30,000 lbs.
Product temperature at loading:			
Range	44° to 30° F.	47° to 34° F.	49° to 32° F.
Average 4/	36.1° F.	38.1° F.	39.7° F.
Product temperature at unloading:			
Range	33° to 21° F.	34° to 23° F.	27° to 22° F.
Average 4/	28.6° F.	29.6° F.	24.1° F.

1/ Outside temperatures, range 59.0° to 82.0° F.
2/ Refrigerator car equipped with basket bunkers and meat rails.
3/ Refrigerator car equipped with forced air-circulating fans.
4/ The average temperatures include all positions both top and bottom of the load.

In car T the same method of icing and re-icing in transit was used; however, 1,200 pounds of dry ice was suspended over the load.

Car U was equipped with forced-air-circulating fans. It was also initially iced and replenished by the shipper, plus 20 percent salt, and was re-iced twice in transit by the carrier with 20 percent salt added. No dry ice was used in this car.

At the start of the test the product temperatures in car S at the top of the load ranged from 32° F. to 44° and averaged 39.5°. On arrival at

destination, temperatures at the top ranged from 31° to 33° and averaged 32°. Temperatures at the bottom of the load at origin ranged from 30° to 37°, averaging 34°, and at destination ranged from 21° to 28°, averaging 25.3°.

In car T temperatures at the top of the load ranged from 35.8° to 47° and averaged 40.8° at origin. At destination the temperatures were reduced to a range of 30° to 34°, averaging 32.5°. The temperatures at the bottom of the load ranged from 34° to 37°, averaging 35.3° at origin, and at destination they ranged from 23° to 30°, averaging 26°.

In car U product temperatures at the top of the load at the packing plant ranged from 40° to 49° and averaged 45.5°, and at destination they were from 25° to 27°, averaging 26.3°. The temperatures at the bottom of the load at the beginning of the test ranged from 32° to 41°, averaging 35.3°, and at the end of the test ranged from 22° to 23°, averaging 22.5°.

The charges for providing each type of protective service were as follows: Car S, $81.63; car T, $101.99; and Car U, $92.75.

The average temperatures for these 3 cars are shown in tables 25, 26 and 27 and figures 24 through 26 in the Appendix.

RESULTS AND CONCLUSIONS

Most shippers are willing to invest in all the refrigeration services that may be necessary to protect their products in transit and deliver them at destination in the best possible condition. In some instances, they buy more refrigeration than is necessary, particularly on shipments moving during the spring and fall when the outside weather is cool. It is the general practice to unload carloads of fresh meats and packinghouse products promptly on arrival and get them into immediate distribution. This condition was amply shown in some of the tests by the large quantities of ice remaining in the bunker upon their return to the packing plants for reloading.

Test I

In this test, comparisons were made with 3 methods of transportation refrigeration services. Car A was initially iced to capacity plus 10 percent salt, and was re-iced once in transit by the railroad plus 10 percent salt. Car B was initially iced to capacity plus 15 percent salt, and was re-iced twice in transit by the railroad plus 15 percent salt. Car C also was initially iced to full bunker capacity and replenished by the shipper with no salt added but instead had 1,152 pounds of dry ice. No re-icing was performed in transit.

As shown in table 1, the maximum product temperature in car A showed a rise from 34° F. at origin to 36° at destination. The minimum product temperature was reduced from 27° to 22° during transit. In car B the

maximum product temperature, which was 42° at origin, 8° higher than in car A, was reduced to 38° upon arrival at destination. The minimum product temperature was reduced from 30° to 26° during the same time.

In other words, the efficiency of the refrigeration service in car B was found to be greater than that in car A even though the product temperatures upon arrival at destination were a few degrees higher. In car C the maximum product temperature fell from 42° at origin to 35° at destination, the minimum product temperature rose from 26° to 29°, and the average remained practically the same.

Considering the temperature differences in the 3 cars and the amount of ice remaining in the bunkers at destination (table 7), the service performed in car A appeared to give adequate protection for spring shipments of well-chilled products at a considerably lower cost than cars B and C. When the product is not well chilled more intense refrigeration may be necessary.

Table 7.--Quantities of ice, salt, and dry ice used in 6 refrigeration tests

Refrigerator car	Ice left in bunker from previous trip	Supplied at origin			Supplied enroute		Total supplied			Remaining in bunker at destination		Total consumed	
		Ice	Salt	Dry ice	Ice	Salt	Ice	Salt	Dry ice	Ice	Dry ice	Ice	Dry ice
	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
A		8,500	800		2,200	220	10,700	1,020		6,700		4,000	
B		10,000	1,200		3,700	555	13,700	1,755		6,600		7,100	
C		8,900		1,152			8,900		1,152	6,800	40	2,100	1,112
D	300	11,850	1,200		4,000	400	16,150	1,600		9,400		6,750	
E		11,750	1,000		3,200	320	14,950	1,320		9,400		5,550	
F	25	12,300	1,500		4,200	630	16,525	2,130		8,000		8,525	
G		12,550	1,500		3,300	495	15,850	1,995		9,600		6,250	
H	8,000	2,600					10,600			9,500		1,100	
I		9,500					9,500			8,550		950	
J	2,400	4,800					7,200			6,480		720	
K	2,500	7,400					9,900			8,660		1,240	
L	2,900	8,700	1,000				11,600	1,000		6,960		4,640	
M	5,800	5,800	1,000		2,200	220	13,800	1,220		10,150		3,650	
N	5,800	5,800	2,000		4,500	900	16,100	2,900		8,700		7,400	
O		11,000			3,600	360	14,600	360		8,190		6,410	
Q		11,500	1,150		4,900	490	16,400	1,640		7,962		8,438	
R		11,000			2,500	250	13,500	250		7,962		5,538	
S		8,300	1,500	600	4,400	660	12,700	2,160	600	7,100	10	5,600	590
T		8,100	1,500	1,200	3,700	555	11,800	2,055	1,200	7,100	50	4,700	1,150
U		12,700	2,000		7,800	1,560	20,500	3,560		9,600		10,900	

Test II

This test is similar to test I except that the car equipped with dry ice bunkers was not included. Cars D and E were initially iced to full bunker capacity plus 10 percent salt and cars F and G were iced in the same way but had 15 percent salt added to the bunker ice. The 4 cars were replenished with crushed ice while the cars were being loaded or shortly after loading was completed. One re-icing was performed in transit by the railroad on each of the cars, and the necessary percentages of salt were added.

As shown in table 2, car D was loaded at a colder temperature than either car E or F. In car D the maximum temperature of the product after loading was completed was 32° F.; upon arrival at destination it had risen to 35°. The minimum product temperature was reduced from 28° to 14° during transit. In car E, which contained 6,800 pounds of frozen product in one end, the maximum temperature of the fresh product was reduced from 40° at origin to 36° upon arrival at destination, and the minimum product temperature was reduced from 36° to 21° during transit. Car F was loaded with fresh pork loins. The maximum product temperature after loading was 41° and was 1° lower upon arrival at destination. The minimum product temperature was reduced from 37° at origin to 26° at destination. Car G was a straight load of frozen pork trimmings loaded at temperatures below 0° and was not included in the temperature comparisons.

Reviewing the refrigerating efficiency of each of the 3 cars, the average product temperature was reduced 1° in car D, 4.8° in car E, and 6.5° in car F.

Test III

The purpose of this test was to compare the performance and the consumption of ice in the late fall in refrigerator cars having varying bunker capacities. The bunker capacities ranged from 7,266 to 10,600 pounds of ice.

The average product temperatures in the 4 cars were reduced in transit and, as shown in table 7, the largest quantity of ice consumed in any of the test cars was only 1,240 pounds.

Considering the small quantity of ice used in the 4 test cars it appears that half-stage icing 3/ would have provided adequate protection for these shipments at a considerable saving in the refrigeration charges.

3/ Half-stage icing service is another modified method of refrigeration provided by the railroads. The icing grates or the floor of the bunkers are raised from the bottom position to a point about halfway to the top of the bunker. This permits the ice used to be reduced to half the normal capacity of the bunker, yet holds it in the position where the most effective refrigerating efficiency can be obtained.

Test IV

Three methods of protective service were compared in this test. The 3 test cars were initially iced to capacity the day before loading, and salt was added to the bunkers while the cars were being loaded. Car L was shipped with 10 percent salt, and no re-icing was performed in transit. Car M had 10 percent salt added and was re-iced once in transit. Car N had 20 percent salt added at origin and was re-iced once in transit by the carrier.

In car L, the product temperatures rose at the door positions but at the other positions either held fairly steady or declined. This indicates there was an air leak in one of the doors.

The product temperatures in car M were reduced in all positions. In car N the product temperatures in all positions were lowered except the top door right side, again indicating that the door was not tight.

Test V

The purpose of this test was to learn whether it is more efficient in transit refrigeration to add salt when the car is initially iced or at the first regular icing station en route.

Cars O and R were initially iced to full bunker capacity by the shipper, no salt being added to the ice at the packing plant. Car Q was initially iced by the shipper and 10 percent salt was mixed in with the ice as the bunkers were being filled.

The 3 cars were re-iced 3 times in transit by the railroads with 10 percent salt added.

As product temperatures in transit and at destination in cars O and Q held within a very close range (the average temperature in car R was lower than in Q), it appears that placing the salt in the bunkers at the time of original icing was not worth the added expense of about $20. However, further tests should be made to establish this point and to determine whether as many as 3 re-icings in transit are necessary.

Test VI

Three comparisons were made in this test, using 2 conventional refrigerator cars and 1 refrigerator car with forced-air-circulating fans built in. The 2 conventional cars, S and T, were initially iced to capacity with 8,000 pounds of crushed ice, and 15 percent salt was added by the shipper. The shipper also initially iced car U to capacity with 11,000 pounds of crushed ice, but added 20 percent salt to the bunker ice. After loading was completed, car S was charged with 600 pounds of dry ice and car T was charged with 1,200 pounds of dry ice suspended from

the meat rails in cheesecloth. The 3 cars were re-iced twice in transit by the carrier, plus the appropriate percentage of salt. With the very narrow difference in temperature in cars S and T, it does not appear that the extra 600 pounds of dry ice in car T had much additional refrigerating effect on the load.

There are a number of interesting points of contrast between this test and previous tests using water ice and salt only. For example, in car A the maximum spread of product temperatures was 14°, in car B 14°, in car D 21°, and in car E 17°. In cars S and T, the comparable spread in the product temperatures was 10° and in car U, equipped with fans, it was only 5°.

The greater efficiency in refrigeration achieved by using the air-circulating fans in car U was obtained at cost of greater ice consumption and consequently a higher charge for the refrigeration service than on cars A, B, D, and E, although less than on car T, but more uniform temperatures were maintained throughout the load.

The consumption of ice in car U, for example, was 10,900 pounds, whereas in car S it was 5,600 pounds, and in car T, 4,700 pounds. Both of these tests were run during the summer months when temperatures were relatively high. However, the meltage of the bunker ice in S and T probably was retarded by the presence of the dry ice in the cars.

Further work in this field is necessary, particularly for the study of the efficiencies and costs of half-stage icing service and cars equipped with air-circulating fans.

Table 8.—Temperature of commodity and air as recorded in car A enroute from Madison, Wis., to Philadelphia, Pa., August 22-26, 1951

PRECOOLING TEST

Place	Date 1951	Time	Outside temp.	Air temperatures TBCL 1/	TBRS	TQCL	TDCL	TDRS	MQCL	BBCL	BBRS	BQCL	BQRS	BDCL	BDRS	Top air Max.	Min.	Av.	Bottom air Max.	Min.	Av.
			°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.
Madison, Wis.	8-22	5:00P	74	66	66	67	67	66	67	68	68	66	65	67	68	67	66	66.4	68	65	67.0
Madison, Wis.	8-22	6:45P	71	Initially iced with 8,000 pounds of crushed ice																	
Madison, Wis.	8-22	6:50P	71	65	67	66	66	66	66	68	66	68	60	67	68	67	65	66.0	68	60	66.2
Madison, Wis.	8-22	9:00P	60	56	57	57	59	62	60	60	59	57	50	61	62	62	56	58.2	62	50	58.2
Madison, Wis.	8-23	12:01A	56	50	51	51	54	55	55	52	53	52	44	56	57	55	50	52.2	57	44	52.3
Madison, Wis.	8-23	6:00A	53	45	46	46	48	50	48	47	47	46	41	49	50	50	45	47.0	50	41	46.7

TRANSIT TEST

Place	Date 1951	Time	Outside tsmp.	Air temperatures TBCL	BBCL	BDCL	Commodity tsmperatures TBCL	TQCL	TDCL	TDRS	MQCL	BBCL	BQCL	BQRS	BDCL	Top commodity Max.	Min.	Av.	Bottom commodity Max.	Min.	Av.
			°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.
Madison, Wis.	8-23	7:00A	56	Doors opened. Loading started																	
Madison, Wis.	8-23	11:00A	68	800 pounds salt added to bunker ice																	
Madison, Wis.	8-23	2:00P	70	500 pounds crushed ice added to bunksrs																	
Madison, Wis.	8-23	4:15P	70	Loading completed. Door closed																	
Madison, Wis.	8-23	4:40P	72	50	30	34	32	27	30	28	29	34	30	31	30	32	27	29.3	34	30	31.3
Madison, Wis.	8-23	7:15P	66	42	28	33	32	28	32	30	29	34	32	32	32	32	28	30.5	34	32	32.5
Proviso, Ill.	8-24	1:15A	52	35	16	28	30	28	32	28	28	28	30	30	30	32	28	29.5	30	28	29.5
Blus Island, Ill.	8-24	9:00A	72	35	18	27	30	30	34	30	28	26	31	30	33	34	30	31.0	33	26	30.0
Logansport, Ind.	8-24	2:15P	82	36	19	28	29	30	34	30	28	24	32	30	32	34	29	30.8	32	24	29.5
Enroute	8-24	6:15P	67	36	20	27	28	29	34	30	27	23	31	29	31	34	28	30.3	31	23	28.5
Columbus, Ohio	8-25	1:30A	60	38	24	30	28	30	36	31	28	22	34	29	32	36	28	31.3	34	22	29.3
Columbus, Ohio	8-25	1:45A	60	Re-iced with 2,200 pounds of crushed ice and 220 pounds of salt																	
Pitcairn, Pa.	8-25	11:05A	76	34	21	29	25	28	35	30	27	22	34	28	30	35	25	29.5	34	22	28.5
Altoona, Pa.	8-25	4:00P	83	36	21	30	26	30	36	30	29	22	36	29	32	36	26	30.5	36	22	29.8
Huntingdon, Pa.	8-25	6:45P	74	37	23	31	27	30	37	32	28	23	33	30	32	37	27	31.5	33	23	29.5
Harrisburg, Pa.	8-25	9:50P	63	37	22	31	26	30	37	31	27	22	34	29	32	37	26	31.0	34	22	29.3
Philadelphia, Pa.	8-26	9:30A	70	36	24	30	26	29	36	31	28	22	32	30	32	36	26	30.5	32	22	29.0
Philadelphia, Pa.	8-26	1:30P	76	Door opsnsd. Unloading startsd																	
Philadslphia, Pa.	8-26	2:45P	78	Unloading completed. Estimatsd 6,700 pounds of crushed ice remaining																	

1/ For explanation of thermometer locations, see page 5.

Table 9.--Temperature of commodity and air as recorded in car B enroute from Madison, Wis., to Philadelphia, Pa., August 22-26, 1951

PRECOOLING TEST

Place	Date 1951	Time	Outside temp.	Air temperatures TBCL 1/	TBRS	TQCL	TDCL	TDRS	MQCL	BBCL	BBRS	BQCL	BQRS	BDCL	BDRS	Top air Max.	Min.	Av.	Bottom air Max.	Min.	Av.
			°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.
Madison, Wis.	8-22	5:10P	74	67	68	68	68	68	70	67	67	70	67	68	68	68	67	67.8	70	67	67.8
Madison, Wis.	8-22	6:15P	71	Initially iced with 8,000 pounds of crushed ice.																	
Madison, Wis.	8-22	6:20P	71	64	66	63	60	66	68	65	66	67	62	66	64	66	60	63.8	67	62	65.0
Madison, Wis.	8-22	9:00P	60	51	60	50	50	54	60	54	58	60	49	51	51	60	50	53.0	60	49	53.8
Madison, Wis.	8-23	12:01A	56	47	55	46	46	49	54	49	53	54	45	46	48	55	46	48.6	54	45	49.2
Madison, Wis.	8-23	6:00A	53	42	48	41	41	42	48	43	46	48	41	41	42	48	41	42.8	48	41	43.5

TRANSIT TEST

Place	Date 1951	Time	Outside temp.	Air temperatures TBCL	BBCL	BDCL	Commodity temperatures TBCL	TQCL	TDCL	TDRS	MQCL	BBCL	BQCL	BQRS	BDCL	Top commodity Max.	Min.	Av.	Bottom commodity Max.	Min.	Av.
			°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.
Madison, Wis.	8-23	7:00A	56	Doors opened, loading started																	
Madison, Wis.	8-23	11:00A	68	1,200 pounds salt added to bunker ice																	
Madison, Wis.	8-23	3:15P	72	2,000 pounds crushed ice added to bunkers																	
Madison, Wis.	8-23	3:30P	72	Loading completed, doors closed																	
Madison, Wis.	8-23	3:45P	72	44	14	29	42	38	32	31	35	30	36	35	33	42	31	35.8	36	30	33.5
Madison, Wis.	8-23	7:15P	66	40	10	26	41	38	32	32	35	29	33	34	32	41	32	35.8	34	29	32.0
Proviso, Ill.	8-24	1:15A	52	36	8	22	40	36	32	32	33	28	30	31	28	40	32	35.0	31	28	29.3
Blue Island, Ill.	8-24	9:00A	72	36	10	23	41	36	33	32	32	29	30	31	27	41	32	35.5	31	27	29.3
Logansport, Ind.	8-24	2:15P	82	38	13	24	39	36	33	33	34	29	30	30	27	39	33	35.3	30	27	29.0
Enroute	8-24	6:15P	67	39	16	26	38	36	33	33	34	29	30	30	26	38	33	35.0	30	26	28.8
Columbus, Ohio	8-25	1:30A	60	40	22	29	40	36	34	34	38	28	31	30	28	40	34	36.0	31	28	29.3
Columbus, Ohio	8-25	1:45A	60	Re-iced with 2,200 pounds of crushed ice and 330 pounds of salt																	
Pitcairn, Pa.	8-25	11:05A	76	35	16	26	42	35	33	33	38	28	30	30	28	42	33	35.8	30	28	29.0
Altoona, Pa.	8-25	4:00P	83	36	16	26	42	36	33	34	38	28	30	30	28	42	33	36.3	30	28	29.0
Huntingdon, Pa.	8-25	6:45P	74	36	16	27	42	36	33	34	37	28	31	30	28	42	33	36.3	31	28	29.3
Huntingdon, Pa.	8-25	7:20P	74	Re-iced with 1,500 pounds of crushed ice and 225 pounds of salt																	
Harrisburg, Pa.	8-25	9:50P	63	36	14	26	38	35	32	33	37	27	30	30	28	38	32	34.5	30	27	28.8
Philadelphia, Pa.	8-26	9:30A	70	34	14	26	38	35	33	34	36	26	31	30	28	38	33	35.0	31	26	28.8
Philadelphia, Pa.	8-26	12:15P	76	Doors opened, unloading started																	
Philadelphia, Pa.	8-26	2:30P	78	Unloading completed - estimated 6,600 pounds of crushed ice remaining																	

1/ For explanation of thermometer locations, see page 5.

Table 10.--Temperature of commodity and air as recorded in car C enroute from Madison, Wis., to Philadelphia, Pa., August 22-26, 1951

PRECOOLING TEST

Place	Date 1951	Time	Outside temp.	Air temperatures TBCL 1/	TBRS	TQCL	TDCL	TDRS	MQCL	BBCL	BBRS	BQCL	BQRS	BDCL	BDRS	Top air Max.	Top air Min.	Top air Av.	Bottom air Max.	Bottom air Min.	Bottom air Av.
			°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.
Madison, Wis.	8-22	5:10P	74	62	64	63	2/	63	64	61	62	64	62	64	64	64	62	63.0	64	61	62.8
Madison, Wis.	8-22	6:30P	71	Initially iced with 8,000 pounds of crushed ice																	
Madison, Wis.	8-22	6:35P	71	59	62	61		60	62	56	58	61	57	61	61	62	59	60.5	61	56	59.0
Madison, Wis.	8-22	9:00P	60	50	55	52		51	56	48	50	53	48	53	54	55	50	52.0	54	48	51.0
Madison, Wis.	8-23	12:01A	56	46	50	48		48	51	44	46	49	44	50	49	50	46	48.0	50	44	47.0
Madison, Wis.	8-23	6:00A	53	42	45	43		43	46	40	42	44	41	44	44	45	42	43.3	44	40	42.5

TRANSIT TEST

Place	Date 1951	Time	Outside temp.	Air temperatures TBCL	BBCL	BDCL	Commodity temperatures TBCL	TQCL	TDCL	TDRS	MQCL	BBCL	BQCL	BQRS	BDCL	Top commodity Max.	Top commodity Min.	Top commodity Av.	Bottom commodity Max.	Bottom commodity Min.	Bottom commodity Av.
			°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.
Madison, Wis.	8-23	2:00P	72	900 pounds of crushed ice added to bunkers																	
Madison, Wis.	8-23	2:30P	72	Doors opened, loading started																	
Madison, Wis.	8-23	5:10P	71	1,152 pounds of dry ice placed in dry ice bunkers																	
Madison, Wis.	8-23	5:15P	71	Loading completed. Doors closed																	
Madison, Wis.	8-23	5:35P	71	50	33	37	32	32	2/	30	26	27	27	30	42	32	30	31.3	42	27	31.5
Madison, Wis.	8-23	7:15P	66	42	32	36	32	32		30	26	28	28	30	42	32	30	31.3	42	28	32.0
Proviso, Ill.	8-24	1:15A	52	36	30	32	30	30		29	26	28	28	29	38	30	29	29.7	38	28	30.8
Blue Island, Ill.	8-24	9:00A	72	33	31	32	31	30		30	27	28	29	30	37	31	30	30.3	37	28	31.0
Logansport, Ind.	8-24	2:15P	82	34	31	32	30	30		30	27	28	29	30	35	30	30	30.0	35	28	30.5
Enroute	8-24	6:15P	67	35	32	32	31	29		29	28	28	29	29	35	31	29	29.7	35	28	30.3
Columbus, Ohio	8-25	1:30A	60	33	32	34	30	29		29	28	29	30	30	34	30	29	29.3	34	29	30.8
Pitcairn, Pa.	8-25	11:15A	76	34	32	33	30	29		29	27	30	28	29	34	30	29	29.3	34	28	30.3
Altoona, Pa.	8-25	4:00P	83	35	33	33	30	29		29	28	29	29	29	34	30	29	29.3	34	29	30.3
Huntingdon, Pa.	8-25	6:45P	74	36	34	33	30	29		29	28	29	29	29	34	30	29	29.3	34	29	30.3
Harrisburg, Pa.	8-25	9:50P	63	36	34	33	30	29		30	28	29	29	29	34	30	29	29.7	34	29	30.3
Philadelphia, Pa.	8-26	9:30A	70	36	34	34	31	30		30	29	30	30	30	35	31	30	30.3	35	30	31.3
Philadelphia, Pa.	8-26	12:50P	77	Doors opened, unloading started																	
Philadelphia, Pa.	8-26	2:45P	78	Unloading completed - Estimated 6,800 pounds of crushed ice remaining																	
Philadelphia, Pa.	8-26	2:45P	78	Estimated 40 pounds of dry ice remaining																	

1/ For explanation of thermometer locations, see page 5.
2/ Thermometer defective

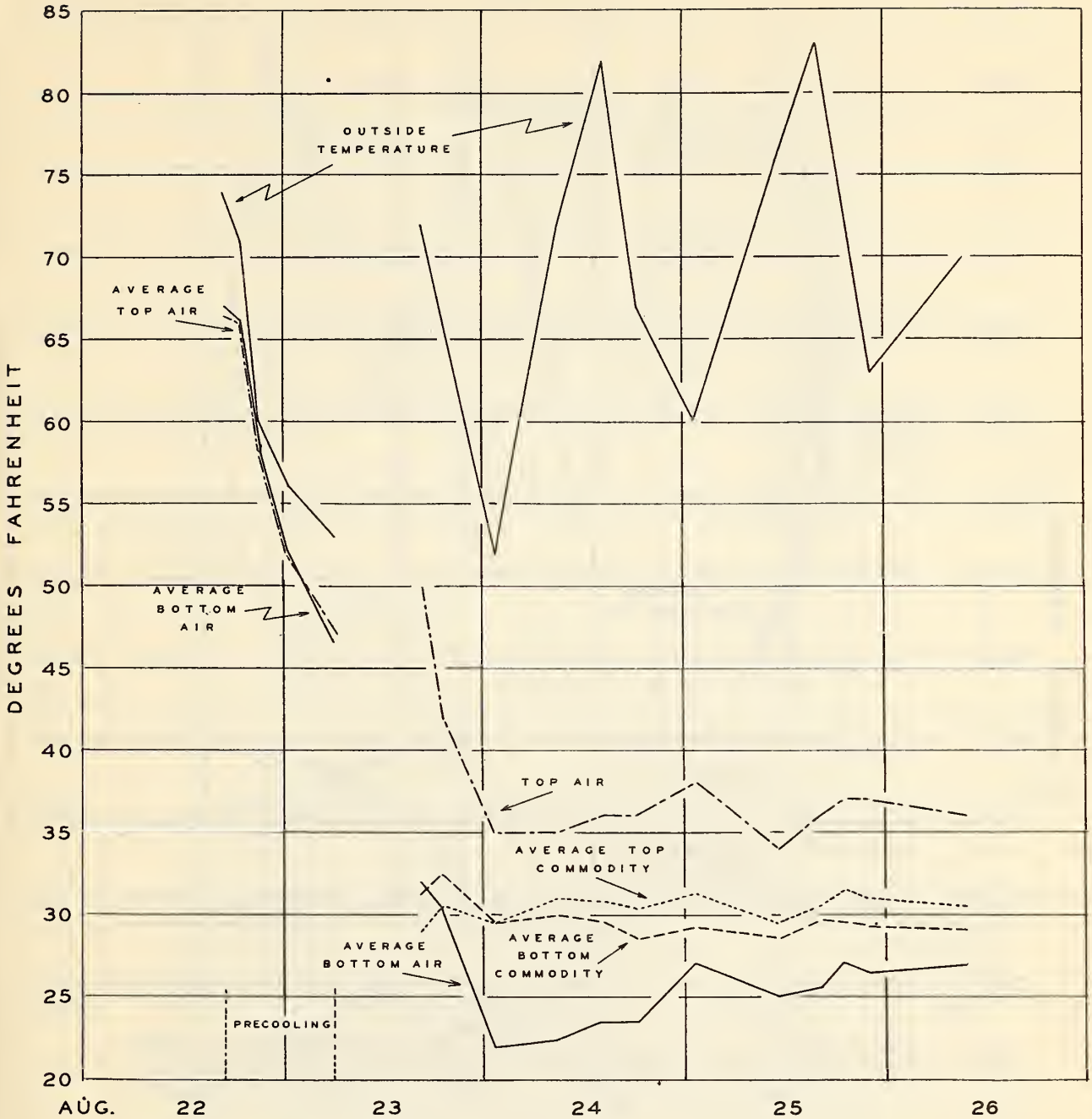


Figure 7.--Precooling and transit temperatures in car A loaded with meat and packinghouse products and shipped from Madison, Wis., to Philadelphia, Pa., August 22-26, 1951.

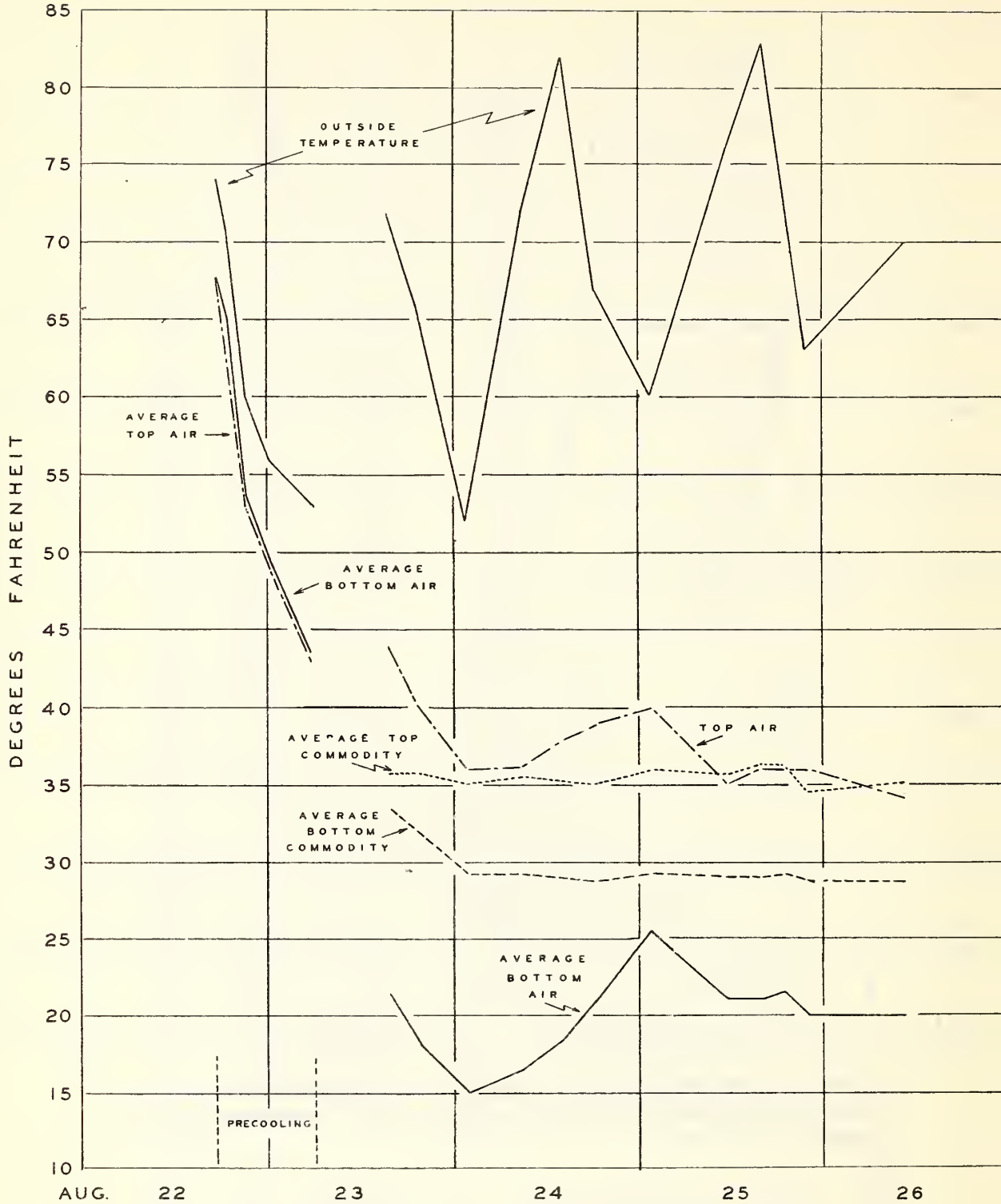


Figure 8.--Precooling and transit temperatures in car B loaded with meat and packinghouse products and shipped from Madison, Wis., to Philadelphia, Pa., August 22-26, 1951.

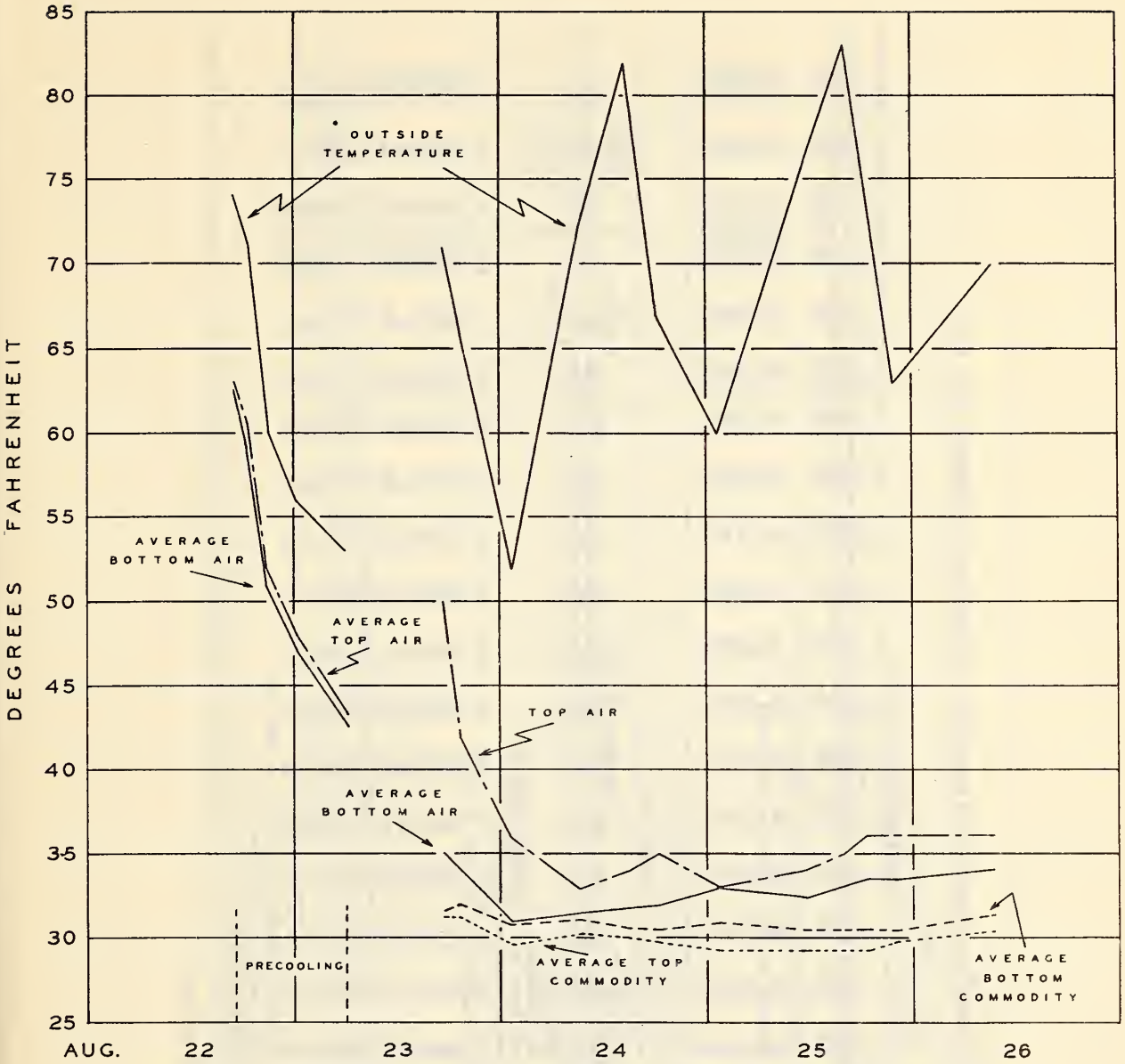


Figure 9.--Precooling and transit temperatures in car C loaded with meat and packinghouse products and shipped from Madison, Wis., to Philadelphia, Pa., August 22-26, 1951.

Table 11.—Temperature of commodity and air as recorded in car D enroute from Madison, Wis., to Philadelphia, Pa., September 24-28, 1951

PRECOOLING TEST

Place	Date 1951	Time	Outside temp.	Air temperatures TBCL 1/	TBRS	TQCL	TDCL	TDRS	MQCL	BBCL	BBRS	BQCL	BQRS	BDCL	BDRS	Top air Max.	Top air Min.	Top air Av.	Bottom air Max.	Bottom air Min.	Bottom air Av.
			°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.
Madison, Wis.	9-24	6:25P		300 pounds old ice remaining in bunker																	
Madison, Wis.	9-24	6:25P	60	44	45	44	40	46	42	46	44	41	43	41	45	46	40	43.8	46	41	43.3
Madison, Wis.	9-24	6:40P	60	Initially iced with 11,300 pounds of crushed ice																	
Madison, Wis.	9-24	9:15P	54	41	42	41	38	44	40	37	40	40	41	38	42	44	38	41.2	42	37	39.7
Madison, Wis.	9-25	12:15A	50	40	40	40	37	41	38	36	39	38	40	37	41	41	37	39.6	41	36	38.5
Madison, Wis.	9-25	6:00A	46	38	38	38	37	40	37	35	38	37	38	36	40	40	37	38.2	40	35	37.3

TRANSIT TEST

Place	Date 1951	Time	Outside temp.	Air temperatures TBCL	BBCL	BDCL	Commodity temperatures TBCL	TQCL	TDCL	TDRS	MQCL	BBCL	BQCL	BQRS	BDCL	Top commodity Max.	Top commodity Min.	Top commodity Av.	Bottom commodity Max.	Bottom commodity Min.	Bottom commodity Av.
			°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.
Madison, Wis.	9-25	8:15A		Doors opened																	
Madison, Wis.	9-25	8:40A		Loading started																	
Madison, Wis.	9-25	10:30A		1200 pounds of salt added to bunker ice																	
Madison, Wis.	9-25	12:01P		Loading completed, doors closed																	
Madison, Wis.	9-25	12:30P	58	38	26	31	30	28	29	32	28	29	28	30	32	32	28	29.8	32	28	29.8
Madison, Wis.	9-25	3:30P		550 pounds crushed ice added to bunker																	
Madison, Wis.	9-25	6:45P	54	31	12	25	28	28	29	33	28	24	28	32	31	33	28	29.5	32	24	28.8
Proviso, Ill.	9-26	1:35A	56	30	7	25	28	28	29	32	28	20	27	32	31	32	28	29.3	32	20	27.5
Dolton, Ill.	9-26	10:00A	60	29	3	20	25	28	28	31	27	16	25	32	29	31	25	28.0	32	16	25.5
Logansport, Ind.	9-26	2:15P	76	32	6	22	26	29	29	32	27	16	25	32	28	32	26	29.0	32	16	25.3
Columbus, Ohio	9-26	9:30P	65	39	9	22	34	30	30	32	27	16	26	32	28	34	30	31.5	32	16	25.5
Columbus, Ohio	9-26	10:00P		Re-iced with 4,000 pounds of crushed ice and 400 pounds of salt																	
Pittsburg, Pa.	9-27	4:45A	68	38	7	22	34	30	30	32	26	15	24	34	28	34	30	31.5	34	15	25.3
Huntingdon, Pa.	9-27	11:15A	75	39	8	25	34	30	30	32	26	14	25	34	28	34	30	31.5	34	14	25.3
Harrisburg, Pa.	9-27	4:00P	78	42	11	26	36	32	31	34	27	15	26	35	29	36	31	33.3	35	15	26.3
Philadelphia, Pa.	9-28	12:45A	72	39	12	26	36	32	32	34	27	15	27	36	29	36	32	33.5	36	15	26.8
Philadelphia, Pa.	9-28	6:45A	60	38	12	26	35	31	31	33	25	14	25	35	28	35	31	32.5	35	14	25.5
Philadelphia, Pa.	9-28	7:00A		Estimated 9,400 pounds of crushed ice remaining																	
Philadelphia, Pa.	9-28	9:15A		Doors opened, unloading started																	
Philadelphia, Pa.	9-28	11:15A		Unloading completed																	

1/ For explanation of thermometer locations, see page 5.

Table 12.--Temperature of commodity and air as recorded in car E enroute from Madison, Wis., to Philadelphia, Pa., September 24-28, 1951

PRECOOLING TEST

Place	Date 1951	Time	Outside temp.	Air temperatures												Top air			Bottom air		
				TBCL 1/	TBRS	TQCL	TDCL	TDRS	MQCL	BBCL	BBRS	BQCL	BQRS	BDCL	BDRS	Max.	Min.	Av.	Max.	Min.	Av.
			°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.
Madison, Wis.	9-24	7:00P	60	59	60	59	58	58	59	58	59	58	59	57	58	60	58	58.8	59	57	58.2
Madison, Wis.	9-24	7:25P	60	Initially iced with 11,600 pounds of crushed ice																	
Madison, Wis.	9-24	9:15P	54	52	54	53	53	53	54	42	53	50	53	49	52	54	52	53.0	53	42	49.8
Madison, Wis.	9-25	12:15A	50	48	50	50	49	49	49	40	49	46	49	46	48	50	48	49.2	49	40	46.3
Madison, Wis.	9-25	6:00A	46	44	45	45	44	44	45	38	44	42	44	42	44	45	44	44.4	44	38	42.3

TRANSIT TEST

Place	Date 1951	Time	Outside temp.	Air temperatures			Commodity temperatures									Top commodity			Bottom commodity		
				TBCL	BBCL	BDCL	TBCL	TQCL	TDCL	TDRS	MQCL	BBCL	BQCL	BQRS	BDCL	Max.	Min.	Av.	Max.	Min.	Av.
			°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.
Madison, Wis.	9-25	8:00A		Doors opened																	
Madison, Wis.	9-25	8:25A		Loading started																	
Madison, Wis.	9-25	10:30A		1,000 pounds of salt added to bunker ice																	
Madison, Wis.	9-25	2:15P		150 pounds of crushed ice added to bunker																	
Madison, Wis.	9-25	3:00P		Loading completed, doors closed																	
Madison, Wis.	9-25	3:15P	62	45	32	19	37	38	37	39	36	37	37	40	38	39	37	37.8	40	37	38.0
Madison, Wis.	9-25	6:45P	54	38	23	16	36	38	36	38	36	36	37	40	35	38	36	37.0	40	35	37.0
Proviso, Ill.	9-26	1:34A	56	34	17	15	35	38	35	37	36	31	37	39	33	38	35	36.3	39	31	35.0
Dolton, Ill.	9-26	10:00A	60	33	14	14	37	37	34	35	36	25	34	36	30	37	34	35.8	36	25	31.3
Logansport, Ind.	9-26	2:15P	76	35	14	16	34	37	34	35	36	24	33	36	31	37	34	35.0	36	24	31.0
Columbus, Ohio	9-26	9:30P	65	37	16	16	34	38	34	34	37	23	33	37	31	38	34	35.0	37	23	31.0
Columbus, Ohio	9-26	10:00P	65	3,200 pounds of crushed ice and 320 pounds of salt added to bunker																	
Pittsburgh, Pa.	9-27	4:45A	68	35	16	18	34	37	34	34	37	22	32	37	31	37	34	34.8	37	22	30.5
Huntingdon, Pa.	9-27	11:15A	75	36	17	18	34	37	33	34	37	22	31	36	30	37	33	34.5	36	22	29.8
Harrisburg, Pa.	9-27	4:00P	78	36	17	19	34	37	33	34	37	21	31	36	31	37	33	34.5	36	21	29.8
Philadelphia, Pa.	9-28	12:45A	72	38	18	20	35	37	33	34	37	22	30	36	30	37	33	34.8	36	22	29.5
Philadelphia, Pa.	9-28	6:45A	60	39	19	21	35	38	34	35	37	21	30	36	30	38	34	35.5	36	21	29.3
Philadelphia, Pa.	9-28	7:00A		Estimated 9,400 pounds of crushed ice remaining																	
Philadelphia, Pa.	9-28	9:00A		Doors opened, unloading started																	
Philadelphia, Pa.	9-28	11:00A		Unloading completed																	

1/ For explanation of thermometer locations, see page 5.

Table 13.--Temperature of commodity and air as recorded in car F enroute from Madison, Wis., to Philadelphia, Pa., September 24-28, 1951

PRECOOLING TEST

Place	Date 1951	Time	Outside temp.	Air temperatures TBCL 1/	TBRS	TQCL	TDCL	TDRS	MQCL	BBCL	BBRS	BQCL	BQRS	BDCL	BDRS	Top air Max.	Top air Min.	Top air Av.	Bottom air Max.	Bottom air Min.	Bottom air Av.
			°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.
Madison, Wis.	9-24	6:25P	60	25 pounds old ice remaining in bunker																	
Madison, Wis.	9-24	6:25P	60	52	52	51	52	51	52	46	51	42	50	50	51	52	51	51.6	51	42	48.3
Madison, Wis.	9-24	7:10P		Initially iced with 11,600 pounds of crushed ice																	
Madison, Wis.	9-24	9:15P	54	45	46	44	46	44	46	38	45	35	43	41	45	46	44	45.0	45	35	41.2
Madison, Wis.	9-25	12:15A	50	42	43	42	43	42	43	37	42	34	41	40	43	43	42	42.4	43	34	39.5
Madison, Wis.	9-25	6:00A	46	40	40	40	40	40	41	35	40	35	40	38	40	40	40	40.0	40	35	38.0

TRANSIT TEST

Place	Date 1951	Time	Outside temp.	Air temperatures TBCL	BBCL	BDCL	Commodity temperatures TBCL	TQCL	TDCL	TDRS	MQCL	BBCL	BQCL	BQRS	BDCL	Top commodity Max.	Top commodity Min.	Top commodity Av.	Bottom commodity Max.	Bottom commodity Min.	Bottom commodity Av.
			°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.
Madison, Wis.	9-25	8:10A		Doors opened																	
Madison, Wis.	9-25	8:20A		Loading started																	
Madison, Wis.	9-25	10:30A		1,500 pounds of salt added to bunker ice																	
Madison, Wis.	9-25	11:00A		Loading completed. Doors closed																	
Madison, Wis.	9-25	11:05A	58	44	33	37	40	40	41	41	40	37	38	41	39	41	40	40.5	41	37	38.8
Madison, Wis.	9-25	12:30P	58	40	29	33	40	40	41	41	39	36	37	39	38	41	40	40.5	39	36	37.5
Madison, Wis.	9-25	3:30P		700 pounds crushed ice added to bunker																	
Madison, Wis.	9-25	6:45P	54	38	17	25	38	40	39	40	37	32	32	33	33	40	38	39.3	33	32	32.5
Proviso, Ill.	9-26	1:35A	56	37	12	20	37	39	37	38	36	30	29	31	30	39	37	37.8	31	29	30.0
Dolton, Ill.	9-26	10:00A	60	37	6	19	36	38	35	35	35	29	27	30	30	38	35	36.0	30	27	29.0
Logansport, Ind.	9-26	2:15P	76	37	8	20	36	37	35	36	34	29	27	30	29	37	35	36.0	30	27	28.8
Columbus, Ohio	9-26	9:30P	65	40	9	22	37	37	36	37	34	29	27	31	29	37	36	36.8	31	27	29.0
Columbus, Ohio	9-26			4,200 pounds of crushed ice and 630 pounds of salt added to bunker																	
Pittsburgh, Pa.	9-27	4:45A	68	38	9	22	36	38	35	36	33	28	27	34	29	38	35	36.3	34	27	29.5
Huntingdon, Pa.	9-27	11:15A	75	39	9	22	36	37	35	36	33	28	27	30	29	37	35	36.0	30	27	28.5
Harrisburg, Pa.	9-27	4:00P	78	41	11	24	37	37	35	36	33	26	26	29	28	37	35	36.3	29	26	27.3
Philadelphia, Pa.	9-28	12:45A	72	43	15	27	39	39	37	37	33	26	27	30	29	39	37	38.0	30	26	28.0
Philadelphia, Pa.	9-28	6:45A	60	44	19	28	40	39	38	38	33	26	26	30	29	40	38	38.8	30	26	27.8
Philadelphia, Pa.	9-28	7:00A		Estimated 8,000 pounds of crushed ice remaining																	
Philadelphia, Pa.	9-28	7:15A		Doors opened. Unloading started																	
Philadelphia, Pa.	9-28	10:05A		Unloading completed.																	

1/ For explanation of thermometer locations, see page 5.

Table 14.--Temperature of commodity and air as recorded in car G enroute from Madison, Wis., to Philadelphia, Pa., September 24-28, 1951

PRECOOLING TEST

Place	Date 1951	Time	Outside temp.	Air temperatures TBCL 1/	TBRS	TQCL	TDCL	TDRS	MQCL	BBCL	BBRS	BQCL	BQRS	BDCL	BDRS	Top air Max.	Min.	Av.	Bottom air Max.	Min.	Av.
			°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.
Madison, Wis.	9-24	6:25P	60	54	54	54	55	56	56	55	54	56	54	54	2/	56	54	54.6	56	54	54.6
Madison, Wis.	9-24	6:55P		Initially iced with 11,600 pounds of crushed ice																	
Madison, Wis.	9-24	9:15P	54	45	45	45	45	46	46	41	46	43	44	41		46	45	45.2	46	41	43.0
Madison, Wis.	9-25	12:15A	50	44	44	44	44	45	45	40	44	42	43	40		45	44	44.2	44	40	41.8
Madison, Wis.	9-25	6:00A	46	40	40	40	40	41	42	38	40	40	40	38	42	41	40	40.2	42	38	39.7

TRANSIT TEST

Place	Date 1951	Time	Outside temp.	Air temperatures TBCL	BBCL	BDCL	Commodity temperatures TBCL	TQCL	TDCL	TDRS	MQCL	BBCL	BQCL	BQRS	BDCL	Top commodity Max.	Min.	Av.	Bottom commodity Max.	Min.	Av.
			°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.
Madison, Wis.	9-25	8:10A		Doors opened																	
Madison, Wis.	9-25	10:30A		1,500 pounds of salt added to bunker ice																	
Madison, Wis.	9-25	1:00P		Loading started																	
Madison, Wis.	9-25	3:30P	62	950 pounds of crushed ice added to bunker																	
Madison, Wis.	9-25	3:35P	62	Loading completed. Doors closed																	
Madison, Wis.	9-25	3:45P	62	44	15	4	7	4	-6	-11	-5	0	-6	-12	-14	7	-11	-1.5	0	-14	-8.0
Madison, Wis.	9-25	6:45P	54	33	10	-6	5	4	-2	-4	-6	2	-6	-10	-11	5	-4	0.8	2	-11	-6.3
Proviso, Ill.	9-26	1:35A	56	26	2	-7	5	6	2	2	-8	0	-8	-6	-6	6	2	3.8	0	-8	-5.0
Dolton, Ill.	9-26	10:00A	60	25	2	-4	5	8	5	7	-6	0	-3	-2	-1	8	5	6.3	0	-3	-1.5
Logansport, Ind.	9-26	2:15P	76	25	2	0	6	9	6	7	-5	0	-2	1	1	9	6	7.0	1	-2	0.0
Columbus, Ohio	9-26	9:30P	65	17	1	1	10	11	7	10	-3	2/	-1	4	2/	11	7	9.5	4	-1	1.5
Columbus, Ohio	9-26	10:00P		3,300 pounds of crushed ice and 495 pounds of salt added to bunker																	
Pittsburgh, Pa.	9-27	4:45A	68	15	1	3	10	12	8	11	-3		-1	5		12	8	10.3	5	-1	2.0
Huntingdon, Pa.	9-27	11:15A	75	15	1	4	10	11	8	11	-3		0	7		11	8	10.0	7	0	3.5
Harrisburg, Pa.	9-27	4:00P	78	17	1	5	11	12	9	12	-2		1	9		12	9	11.0	9	1	5.0
Philadelphia, Pa.	9-28	12:45A	72	19	1	5	12	14	9	13	-1		1	10		14	9	12.0	10	1	5.5
Philadelphia, Pa.	9-28	6:45A	60	20	2	6	13	15	10	14	0		3	10		15	10	13.0	10	3	6.5
Philadelphia, Pa.	9-28	7:00A		Estimated 9,600 pounds of crushed ice remaining																	
Philadelphia, Pa.	9-28	7:20A		Doors opened. Unloading started																	
Philadelphia, Pa.	9-28	10:00A		Unloading completed																	

1/ For explanation of thermometer locations, see page 5.
2/ Thermometer defective.

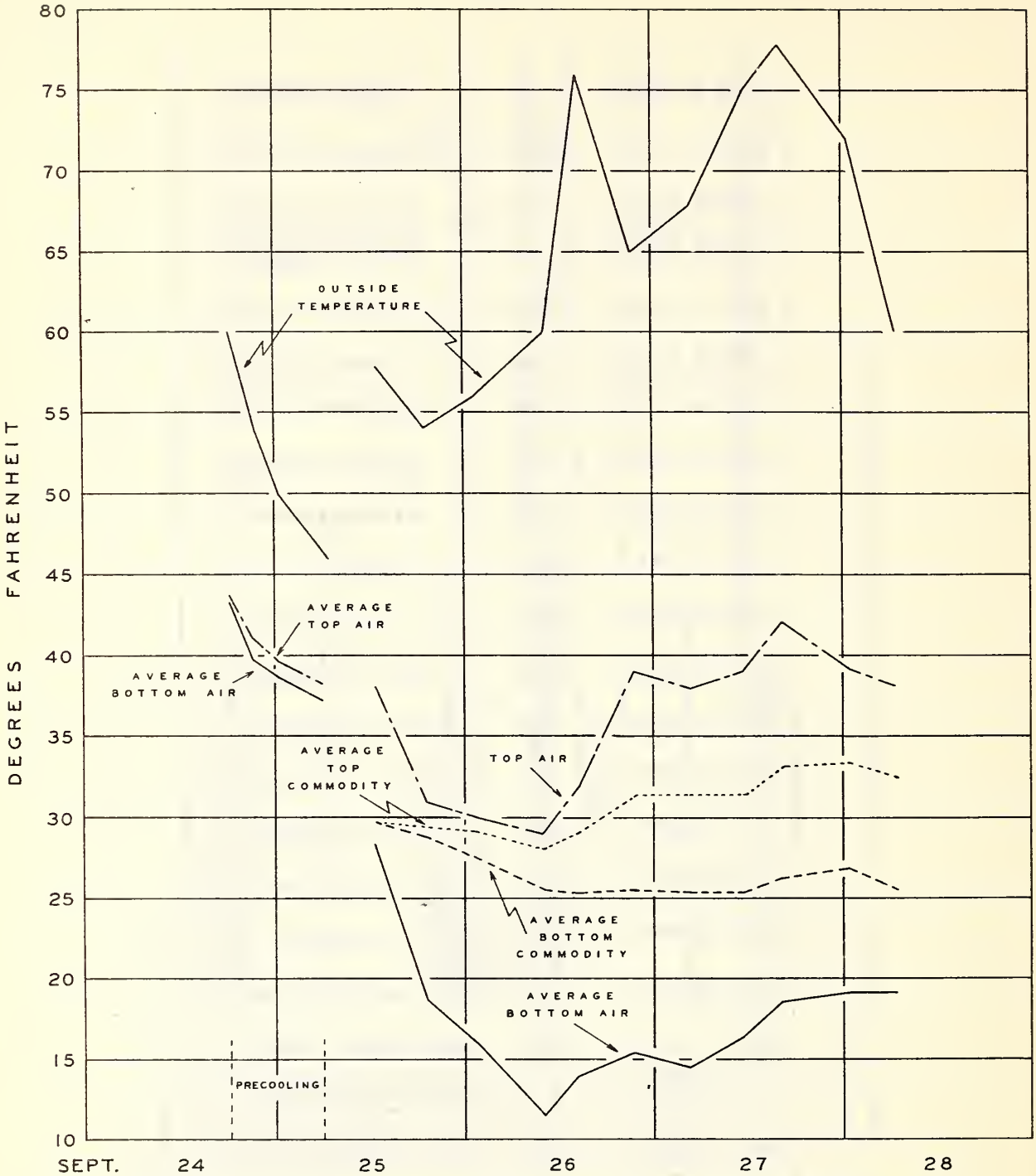


Figure 10.--Precooling and transit temperatures in car D loaded with meat and packinghouse products and shipped from Madison, Wis., to Philadelphia, Pa., September 24-28, 1951.

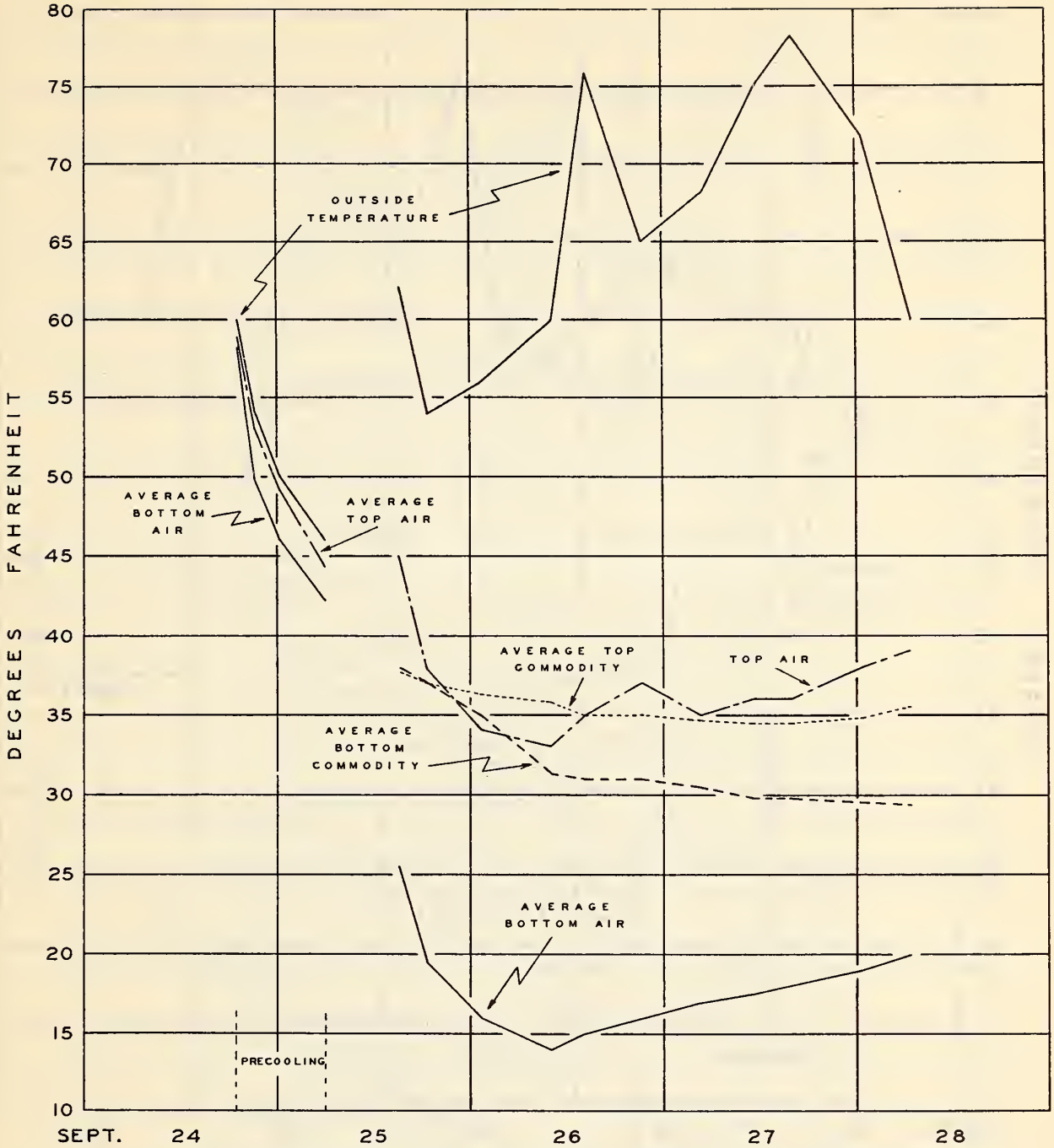


Figure 11.--Precooling and transit temperatures in car E loaded with meat and packinghouse products and shipped from Madison, Wis., to Philadelphia, Pa., September 24-28, 1951.

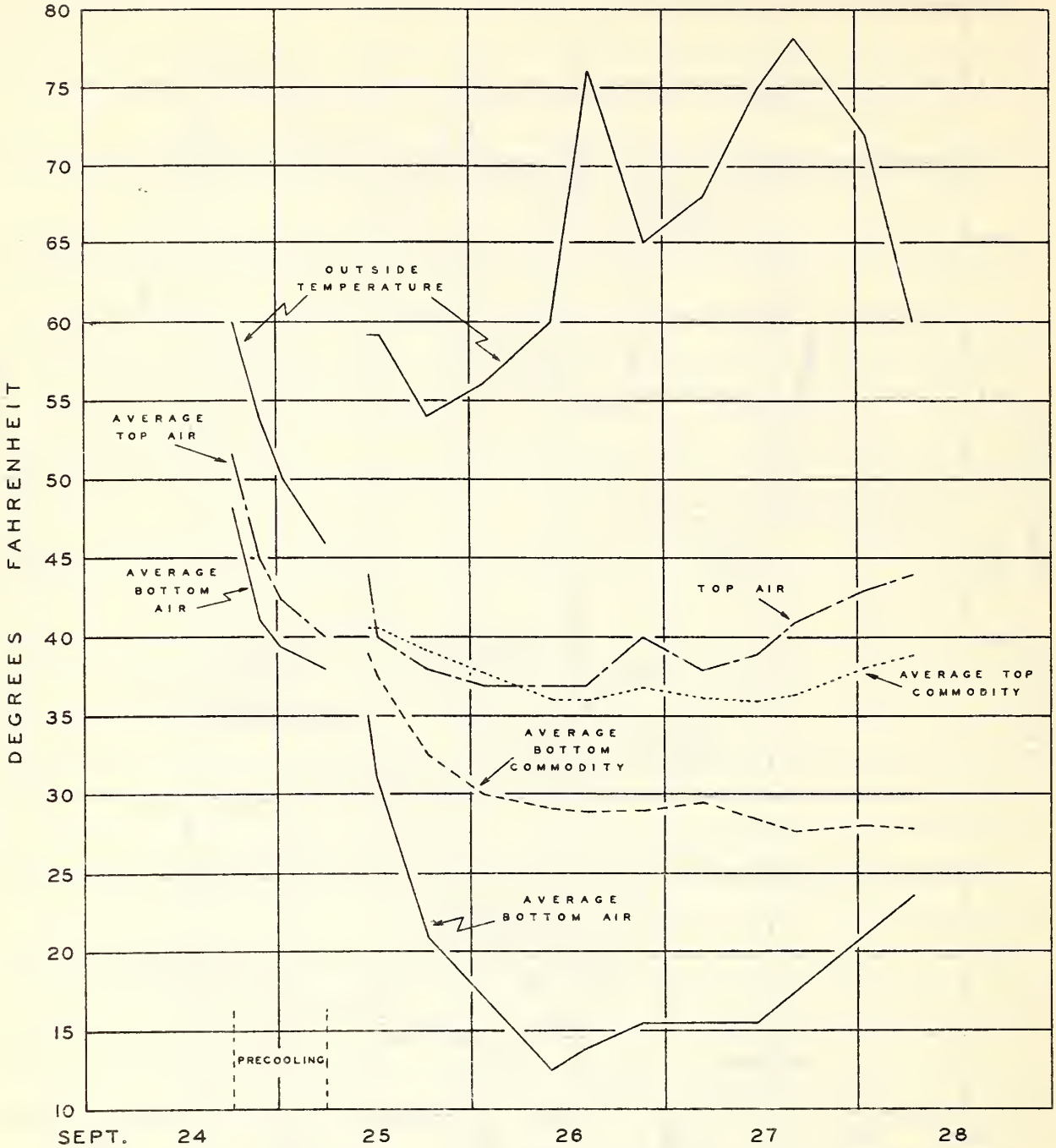


Figure 12.--Precooling and transit temperatures in car F loaded with meat and packinghouse products and shipped from Madison, Wis., to Philadelphia, Pa., September 24-28, 1951.

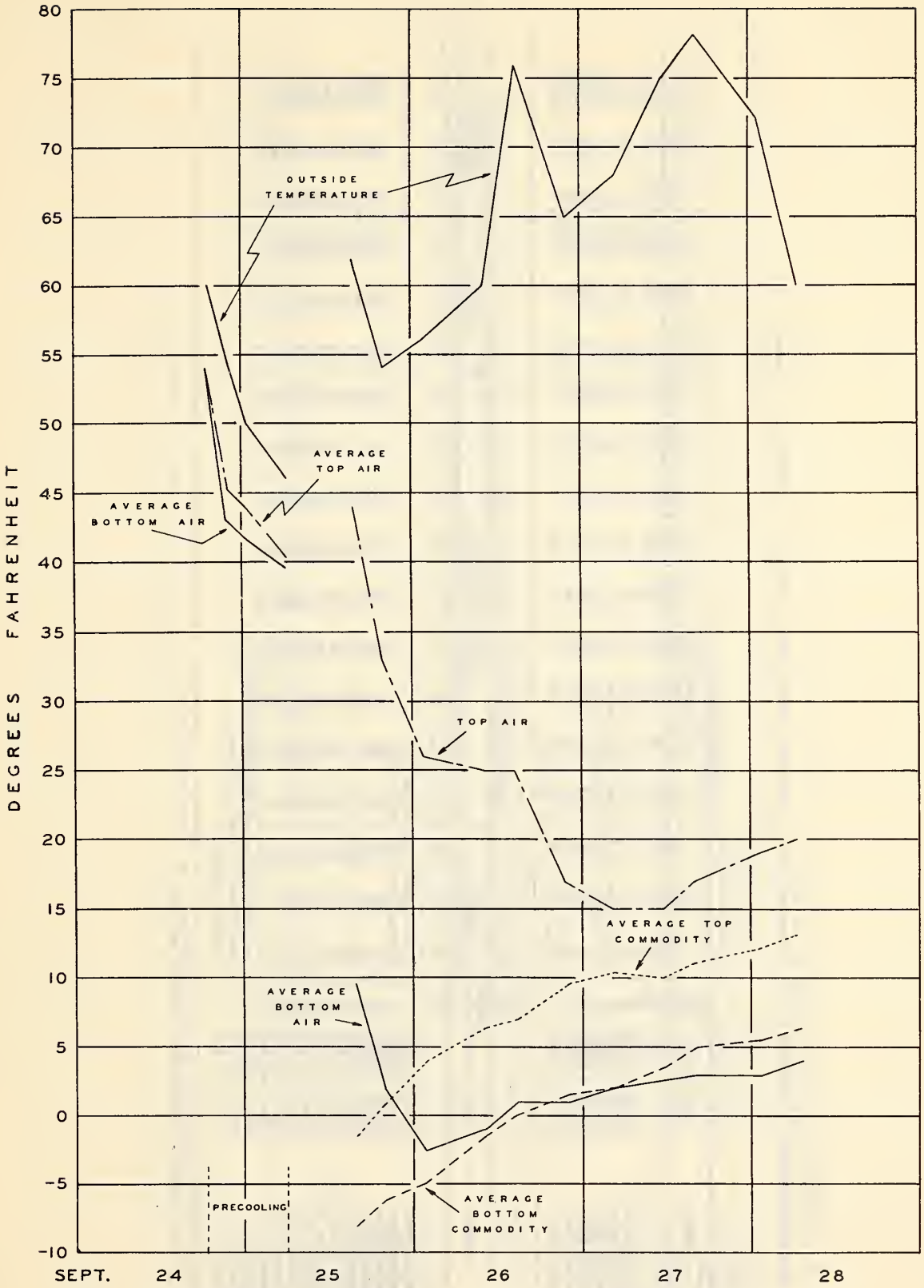


Figure 13.--Precooling and transit temperatures in car G loaded with meat and packinghouse products and shipped from Madison, Wis., to Philadelphia, Pa., September 24-28, 1951.

Table 15.—Temperature of commodity and air as recorded in car H enroute from Austin, Minn., to Newark, N. J., October 31 - November 5, 1951

PRECOOLING TEST

Place	Date 1951	Time	Outside temp.	Air temperatures TBCL 1/	TBRS	TQCL	TDCL	TDRS	MQCL	BBCL	BBRS	BQCL	BQRS	BDCL	BDRS	Top air Max.	Min.	Av.	Bottom air Max.	Min.	Av.
			°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.
Austin, Minn.	10-31	9:00A	26	32	33	31	33	33	32	29	31	32	32	31	32	33	31	32.4	32	29	31.2
Austin, Minn.	10-31	9:45A	26	8,000 pounds old ice remaining in bunker																	
Austin, Minn.	10-31	9:45A	26	2,600 pounds crushed ice added to bunker																	
Austin, Minn.	10-31	3:00P	32	31	33	31	33	34	32	29	29	32	32	31	32	34	31	32.4	32	29	30.8
Austin, Minn.	10-31	10:00P	29	28	30	28	30	30	29	26	26	29	29	28	29	30	28	29.2	29	26	27.8
Austin, Minn.	11- 1	9:00A	29	28	30	28	30	30	30	28	28	30	30	29	30	30	28	29.2	30	28	29.2

TRANSIT TEST

Place	Date 1951	Time	Outside temp.	Air temperatures TBCL	BBCL	BDCL	Commodity temperatures TBCL	TQCL	TDCL	TDRS	MQCL	BBCL	BQCL	BQRS	BDCL	Top commodity Max.	Min.	Av.	Bottom commodity Max.	Min.	Av.
			°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.
Austin, Minn.	11- 1	11:30A		Doors opened, loading started																	
Austin, Minn.	11- 1	2:20P		Loading completed, doors closed																	
Austin, Minn.	11- 1	4:30P	23	34	29	30	37	34	42	38	34	35	36	36	32	42	34	37.8	36	32	34.8
Austin, Minn.	11- 1	8:30P	16	34	30	30	36	34	40	36	34	34	35	35	32	40	34	36.5	35	32	34.0
Savanna, Ill.	11- 2	8:00A	16	32	28	29	34	34	35	33	34	32	34	34	30	35	33	34.0	34	30	32.5
Blue Island, Ill.	11- 2	3:00P	25	32	28	29	34	35	34	32	35	32	34	33	30	35	32	33.8	34	30	32.3
Fort Wayne, Ind.	11- 3	1:00A	23	32	29	30	34	34	34	32	35	32	34	32	30	34	32	33.5	34	30	32.0
Conneaut, Ohio	11- 3	10:30A	28	31	28	29	34	34	33	31	35	31	32	32	30	34	31	33.0	32	30	31.3
Buffalo, N. Y.	11- 3	7:00P	27	31	29	29	33	34	33	31	35	31	31	31	29	34	31	32.8	31	29	30.5
Packerton, Pa.	11- 4	12:30P	46	30	29	30	33	33	32	30	34	31	31	30	30	33	30	32.0	31	30	30.5
Newark, N. J.	11- 4	10:00P	28	32	28	30	34	33	33	32	34	31	35	30	30	34	32	33.0	35	30	31.5
Newark, N. J.	11- 4	10:00P	28	Estimated 9,500 pounds of crushed ice remaining																	
Newark, N. J.	11- 5	1:00A		Doors opened, unloading started																	
Newark, N. J.	11- 5	3:30A		Unloading completed																	

1/ For explanation of thermometer locations, see page 5.

Table 16.—Temperature of commodity and air as recorded in car I enroute from Austin, Minn., to Newark, N. J., October 31 - November 5, 1951

PRECOOLING TEST

Place	Date 1951	Time	Outside temp.	Air temperatures TBCL 1/	TBRS	TQCL	TDCL	TDRS	MQCL	BBCL	BBRS	BQCL	BQRS	BDCL	BDRS	Top air Max.	Min.	Av.	Bottom air Max.	Min.	Av.
			°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.
Austin, Minn.	10-31	9:00A	26	25	25	27	32	25	25	25	24	24	24	2/	24	32	25	26.8	25	24	24.2
Austin, Minn.	10-31	9:45A	26	Initially iced with 9,500 pounds of crushed ice																	
Austin, Minn.	10-31	3:00P	32	30	30	31	31	30	29	29	29	29	28		28	31	30	30.4	29	28	28.6
Austin, Minn.	10-31	10:00P	29	28	29	30	32	29	29	28	28	28	28		28	32	28	29.6	28	28	28.0
Austin, Minn.	11- 1	9:00A	29	27	27	29	30	27	27	27	27	27	26		27	30	27	28.0	27	26	26.8

TRANSIT TEST

Place	Date 1951	Time	Outside temp.	Air temperatures TBCL	BBCL	BDCL	Commodity temperatures TBCL	TQCL	TDCL	TDRS	MQCL	BBCL	BQCL	BQRS	BDCL	Top commodity Max.	Min.	Av.	Bottom commodity Max.	Min.	Av.
			°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.
Austin, Minn.	11- 1	11:30A		Doors opened, loading started																	
Austin, Minn.	11- 1	2:10P		Loading completed, doors closed																	
Austin, Minn.	11- 1	4:30P	23	33	27	2/	38	44	42	44	36	17	35	32	30	44	38	42.0	35	17	28.5
Austin, Minn.	11- 1	8:30P	16	35	28		38	46	43	44	36	20	36	33	31	46	38	42.8	36	20	30.0
Savanna, Ill.	11- 2	8:00A	16	33	26		34	44	40	39	33	20	32	30	28	44	34	39.3	32	20	27.5
Blue Island, Ill.	11- 2	3:00P	25	33	28		35	2/	41	39	33	23	33	31	29	41	35	38.3	33	23	29.0
Fort Wayne, Ind.	11- 3	1:00A	23	34	28		34		--	37	33	24	32	30	28	37	34	35.7	32	24	28.5
Conneaut, Ohio	11- 3	10:30A	28	35	27		34		35	35	32	23	31	29	27	35	34	34.7	31	23	27.5
Buffalo, N. Y.	11- 3	7:00P	27	34	28		34		34	35	33	24	31	29	28	35	34	34.3	31	24	28.0
Packerton, Pa.	11- 4	12:30P	46	33	28		33		33	33	32	24	30	30	28	33	33	33.0	30	24	28.0
Newark, N. J.	11- 4	10:00P	28	35	29		33		33	33	32	25	30	29	30	33	33	33.0	30	25	28.5
Newark, N. J.	11- 4	10:00P		Estimated 8,550 pounds of crushed ice remaining																	
Newark, N. J.	11- 5	4:30A		Doors opened for unloading																	
Newark, N. J.	11- 5	5:00A		Unloading started																	
Newark, N. J.	11- 5	7:30A		Unloading completed																	

1/ For explanation of thermometer locations, see page 5.
2/ Thermometer defective.

Table 17.--Temperature of commodity and air as recorded in car J enroute from Austin, Minn., to Newark, N. J., October 31 - November 5, 1951

PRECOOLING TEST

Place	Date 1951	Time	Outside temp.	Air temperatures TBCL 1/	TBRS	TQCL	TDCL	TDRS	MQCL	BBCL	BBRS	BQCL	BQRS	BDCL	BDRS	Top air Max.	Min.	Av.	Bottom air Max.	Min.	Av.
			°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.
Austin, Minn.	10-31	9:00A	26	25	24	24	25	24	28	26	25	24	25	24	23	25	24	24.4	26	23	24.5
Austin, Minn.	10-31	9:45A	26	2,400 pounds old ice remaining in bunker																	
Austin, Minn.	10-31	9-45A	26	4,800 pounds crushed ice added to bunker																	
Austin, Minn.	10-31	3:00P	32	30	29	28	29	29	30	29	29	28	28	28	27	30	28	29.0	29	27	28.2
Austin, Minn.	10-31	10:00P	29	28	28	27	28	28	30	28	28	27	27	27	27	28	27	27.8	28	27	27.3
Austin, Minn.	11- 1	7:00A	29	27	27	29	30	27	27	27	27	27	26	27	27	30	27	28.0	27	26	26.8

TRANSIT TEST

Place	Date 1951	Time	Outside temp.	Air temperatures TBCL	BBCL	BDCL	Commodity temperatures TBCL	TQCL	TDCL	TDRS	MQCL	BBCL	BQCL	BQRS	BDCL	Top commodity Max.	Min.	Av.	Bottom commodity Max.	Min.	Av.
			°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.
Austin, Minn.	11- 1	8:00A	34	Doors opened. (Car moved into plant)																	
Austin, Minn.	11- 1	1:30P		Loading started																	
Austin, Minn.	11- 1	2:55P		Loading completed. (Car moved out of plant) Doors closed																	
Austin, Minn.	11- 1	4:30P	23	33	29	35	33	37	2/	32	34	31	30	34	35	37	32	34.0	35	30	32.5
Austin, Minn.	11- 1	8:30P	16	34	30	35	34	36		32	36	32	32	33	34	36	32	34.0	34	32	32.8
Savanna, Ill.	11- 2	8:00A	16	34	31	34	35	35		33	34	32	33	31	32	35	33	34.3	33	31	32.0
Blue Island, Ill.	11- 2	3:00P	25	34	31	32	34	35		33	33	32	33	31	31	35	33	34.0	33	31	31.8
Fort Wayne, Ind.	11- 3	1:00A	23	34	31	32	34	34		34	34	32	33	31	30	34	34	34.0	33	30	31.5
Conneaut, Ohio	11- 3	10:30A	28	33	31	31	33	34		34	33	31	32	30	30	34	33	33.7	32	30	30.8
Buffalo, N. Y.	11- 3	7:00P	27	33	31	32	33	34		33	33	32	32	30	30	34	33	33.3	32	30	31.0
Packerton, Pa.	11- 4	12:30P	46	32	31	31	33	33		33	32	30	32	30	29	33	33	33.0	32	29	30.3
Newark, N. J.	11- 4	10:00P	28	32	31	31	33	33		33	32	31	33	30	29	33	33	33.0	33	29	30.8
Newark, N. J.	11- 4	10:00P		Estimated 6,480 pounds of crushed ice remaining																	
Newark, N. J.	11- 4	11:00P		Doors opened for unloading																	
Newark, N. J.	11- 5	12:15A		Unloading started																	
Newark, N. J.	11- 5	3:00A		Unloading completed																	

1/ For explanation of thermometer locations, see page 5.
2/ Thermometer defective.

Table 18.—Temperature of commodity and air as recorded in car K enroute from Austin, Minn., to Newark, N. J., October 31 - November 5, 1951

PRECOOLING TEST

Place	Date 1951	Time	Outside temp.	Air temperatures TBCL 1/	TBRS	TQCL	TDCL	TDRS	MQCL	BBCL	BBRS	BQCL	BQRS	BDCL	BDRS	Top air Max.	Min.	Av.	Bottom air Max.	Min.	Av.
			°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.
Austin, Minn.	10-31	9:00A	26	28	28	30	28	29	28	29	28	28	28	27	27	30	28	28.6	29	27	27.8
Austin, Minn.	10-31	9:45A	26	2,500 pounds old ice remaining in bunkers																	
Austin, Minn.	10-31	9:45A	26	7,400 pounds crushed ice added to bunkers																	
Austin, Minn.	10-31	3:00P	32	30	30	30	30	31	30	31	30	30	30	30	30	31	30	30.2	31	30	30.2
Austin, Minn.	10-31	10:00P	29	31	32	31	31	31	30	32	31	31	32	31	31	32	31	31.2	32	31	31.3

TRANSIT TEST

Place	Date 1951	Time	Outside temp.	Air temperatures TBCL	BBCL	BDCL	Commodity temperatures TBCL	TQCL	TDCL	TDRS	MQCL	BBCL	BQCL	BQRS	BDCL	Top commodity Max.	Min.	Av.	Bottom commodity Max.	Min.	Av.
			°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.
Austin, Minn.	11-1	8:00A	34	Doors opened (Car moved into plant)																	
Austin, Minn.	11-1	10:30A		Loading started																	
Austin, Minn.	11-1	2:40P		Loading completed (Car moved from plant) Doors closed																	
Austin, Minn.	11-1	4:30P	23	36	30	36	27	40	39	36	36	25	38	35	31	40	27	35.5	38	25	32.3
Austin, Minn.	11-1	8:30P	16	37	30	35	28	39	38	37	35	28	37	34	30	39	28	35.5	37	28	32.3
Savanna, Ill.	11-2	8:00A	16	37	30	34	29	39	39	35	35	28	36	32	31	39	29	35.5	36	28	31.8
Blue Island, Ill.	11-2	3:00P	25	37	30	33	29	38	38	35	35	29	35	31	31	38	29	35.0	35	29	31.5
Fort Wayne, Ind.	11-3	1:00A	23	36	30	32	29	38	38	34	34	29	33	30	30	38	29	34.8	33	29	30.5
Conneaut, Ohio	11-3	10:30A	28	36	30	31	30	37	37	33	33	29	33	32	30	37	30	34.3	33	29	31.0
Buffalo, N. Y.	11-3	7:00P	27	37	31	32	30	39	37	34	33	30	33	31	31	39	30	35.0	33	30	31.3
Packerton, Pa.	11-4	12:30P	46	36	31	31	30	37	36	33	33	30	32	31	31	37	30	34.0	32	30	31.0
Newark, N. J.	11-4	10:00P	28	38	32	31	30	37	36	32	33	30	32	31	31	37	30	33.8	32	30	31.0
Newark, N. J.	11-4	10:00P		Estimated 8,660 pounds of crushed ice remaining in bunkers																	
Newark, N. J.	11-4	10:10P		Doors opened for unloading																	
Newark, N. J.	11-5	2:00A		Unloading started																	
Newark, N. J.	11-5	5:30A		Unloading completed																	

1/ For explanation of thermometer locations, see page 5.

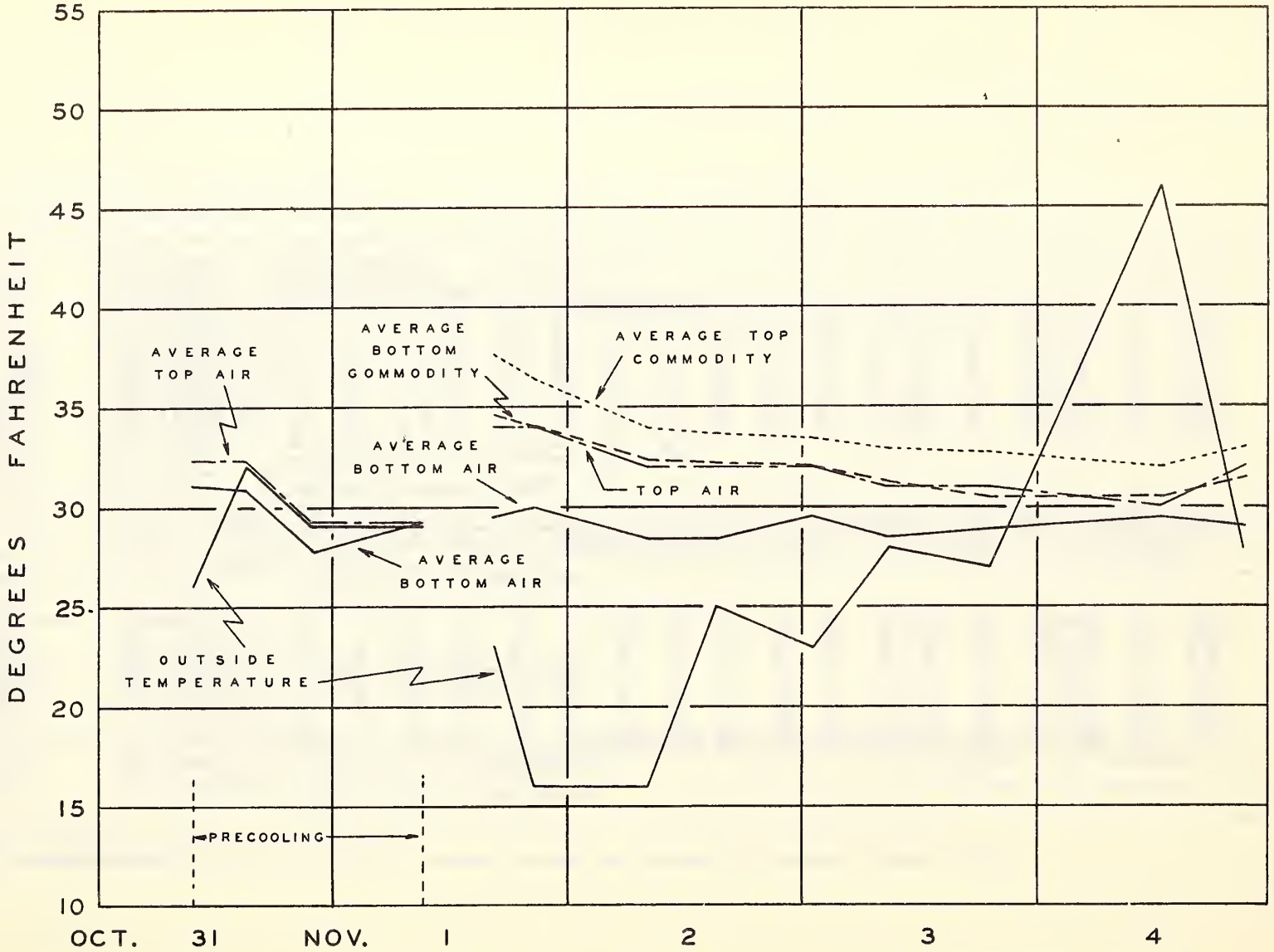


Figure 14.--Precooling and transit temperatures in car H loaded with meat and packinghouse products shipped from Austin, Minn., to Newark, N. J., November 1-5, 1951.

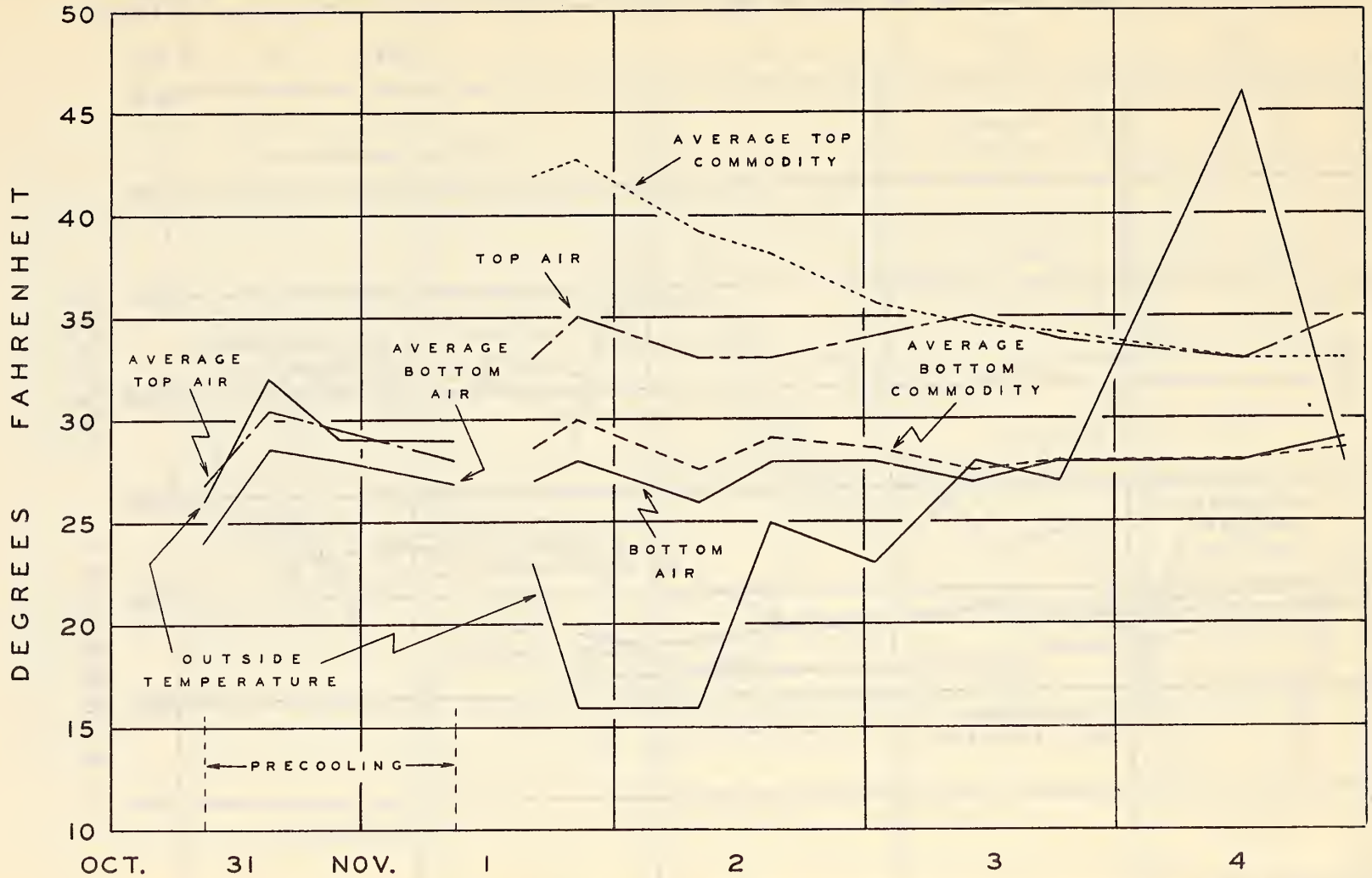


Figure 15.--Precooling and transit temperatures in car I loaded with meat and packinghouse products and shipped from Austin, Minn., to Newark, N. J., October 31 to November 5, 1951.

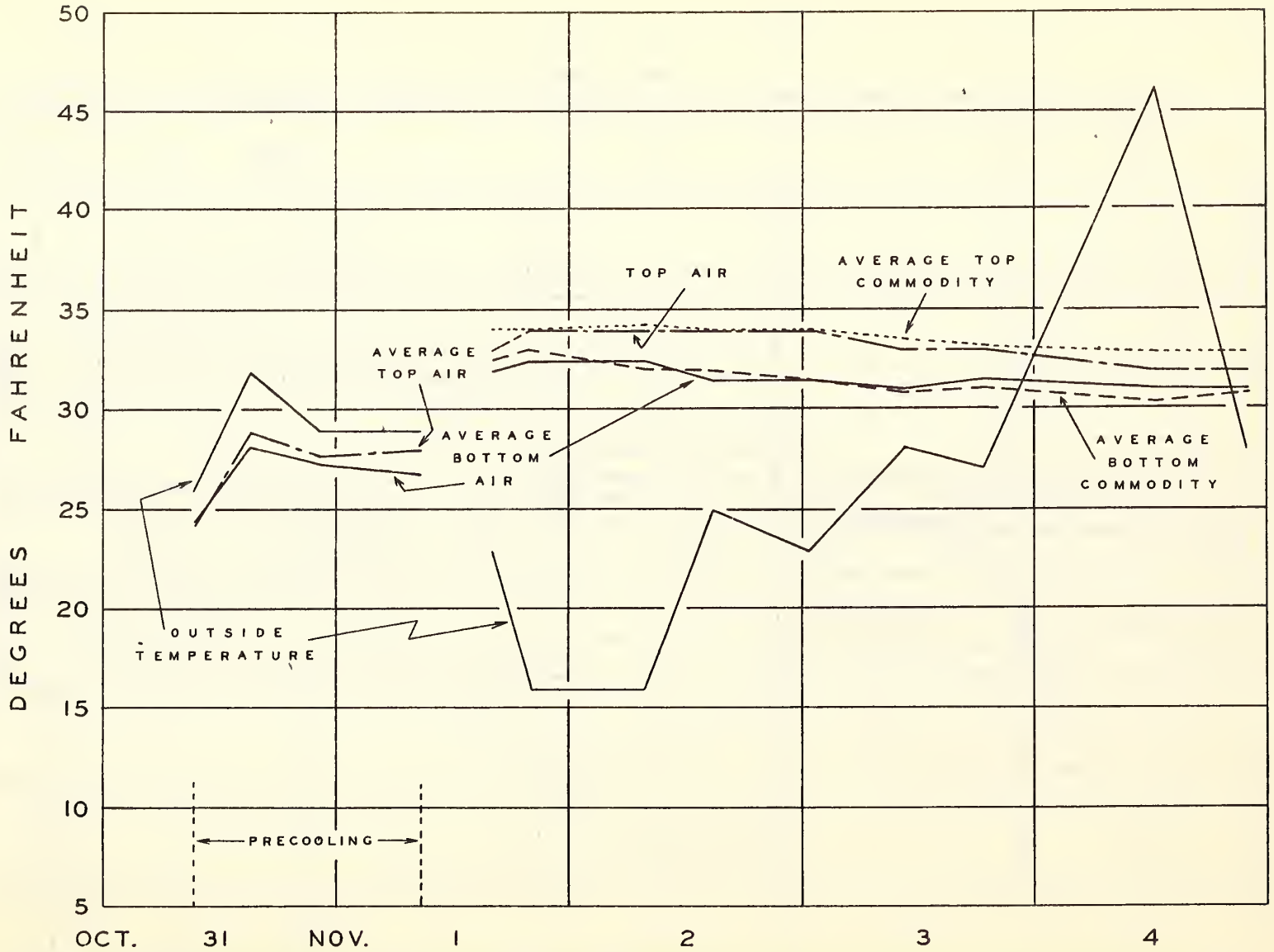


Figure 16.--Precooling and transit temperatures in car J loaded with meat and packinghouse products and shipped from Austin, Minn., to Newark, N. J., October 31 to November 5, 1951.

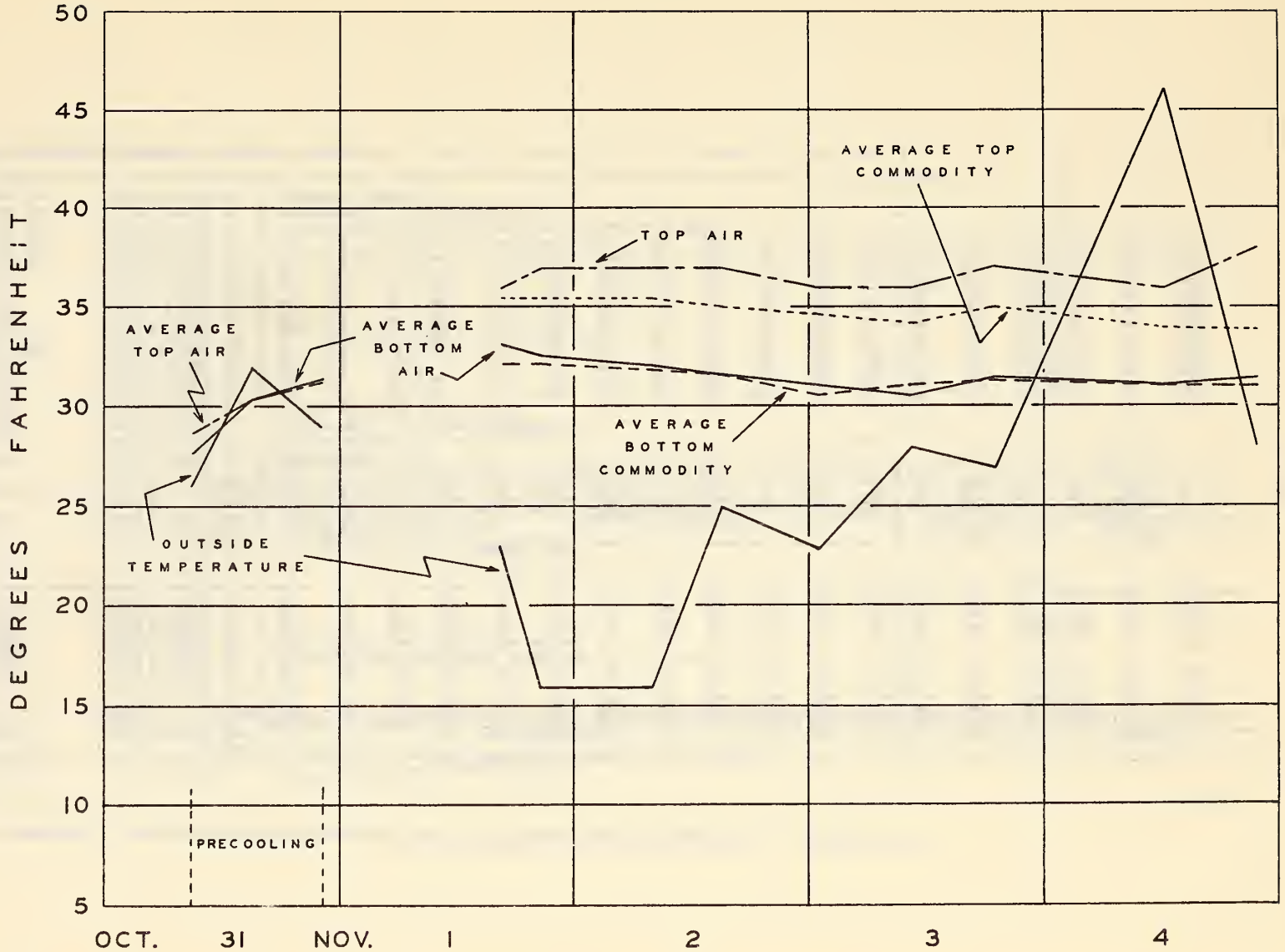


Figure 17.--Precooling and transit temperatures in car K loaded with meat and packinghouse products and shipped from Austin, Minn., to Newark, N. J., October 31 to November 5, 1951.

Table 19.—Temperature of commodity and air as recorded in car L enroute from Madison, Wis., to Philadelphia, Pa., May 19-23, 1952

PRECOOLING TEST

Place	Date 1952	Time	Outsides temp.	Air temperatures TBCL 1/	TBRS	TQCL	TDCL	TDRS	MQCL	BBCL	BBRS	BQCL	BQRS	BDCL	BDRS	Top air Max.	Top air Min.	Top air Av.	Bottom air Max.	Bottom air Min.	Bottom air Av.
			°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.
Madison, Wis.	5-19	7:35P:	62	51	47	51	51	51	48	44	49	51	50	50	48	51	47	50.2	51	44	48.7
Madison, Wis.	5-19	7:35P:	62	2,900 pounds old ice remaining in bunkers																	
Madison, Wis.	5-19	7:35P:	62	8,700 pounds crushed ice added to bunkers																	
Madison, Wis.	5-19	10:30P:	48	50	46	49	50	49	47	42	48	49	49	49	45	50	46	48.8	49	42	47.0
Madison, Wis.	5-20	7:15A:	55	43	40	43	42	43	42	37	42	43	43	43	41	43	40	42.2	43	37	41.5

TRANSIT TEST

Place	Date 1952	Time	Outside temp.	Air temperatures TBCL	BBCL	BDCL	Commodity temperatures TBCL	TQCL	TDCL	TDRS	MQCL	BBCL	BQCL	BQRS	BDCL	Top commodity Max.	Top commodity Min.	Top commodity Av.	Bottom commodity Max.	Bottom commodity Min.	Bottom commodity Av.
			°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.
Madison, Wis.	5:20	8:15A:	57	Doors opened																	
Madison, Wis.	5-20	11:45A:		Loading started																	
Madison, Wis.	5-20	1:45P:		1,000 pounds of salt added to bunker ice																	
Madison, Wis.	5-20	3:10P:	66	Loading completed, doors closed																	
Madison, Wis.	5-20	3:10P:	66	54	38	42	46	44	41	44	44	40	41	43	40	46	41	43.8	43	40	41.0
Madison, Wis.	5-20	6:20P:	53	48	32	46	44	46	54	53	46	40	44	44	44	54	44	49.3	44	40	43.0
Proviso, Ill.	5-21	1:40A:	48	44	24	44	44	46	50	51	45	32	41	40	44	51	44	47.8	44	32	39.3
Blue Island, Ill.	5-21	6:00A:	49	43	25	43	44	46	48	50	44	30	39	38	43	50	44	47.0	43	30	37.5
Logansport, Ind.	5-21	2:15P:	75	43	25	40	43	45	46	48	43	29	36	35	43	48	43	45.5	43	29	35.8
Columbus, Ohio	5-21	9:30P:	62	47	27	41	43	45	47	49	44	29	35	35	43	49	43	46.0	43	29	35.5
Pitcairn, Pa.	5-22	5:00A:	50	46	29	42	44	45	47	49	44	31	35	35	43	49	44	46.3	43	31	36.0
Altoona, Pa.	5-22	9:50A:	73	45	30	42	43	45	46	49	43	30	34	35	44	49	43	45.8	44	30	35.8
Enola, Pa.	5-22	4:10P:	78	48	31	42	44	45	47	49	43	32	35	37	44	49	44	46.3	44	32	37.0
Philadelphia, Pa.	5-22	11:50P:	66	48	32	43	44	46	47	49	43	33	36	37	44	49	44	46.5	44	33	37.5
Philadelphia, Pa.	5-23	7:15A:	60	48	32	44	45	46	47	50	44	34	36	38	45	50	45	47.0	45	34	38.3
Philadelphia, Pa.	5-23	9:15A:	66	Estimated 6,960 pounds of crushed ice remaining in bunkers																	
Philadelphia, Pa.	5-23	9:15A:	66	Doors opened, unloading started																	
Philadelphia, Pa.	5-23	11:15A:	69	Unloading completed																	

1/ For explanation of thermometer locations, see page 5.

Table 20.--Temperature of commodity and air as recorded in car M enroute from Madison, Wis., to Philadelphia, Pa., May 19-23, 1952

PRECOOLING TEST

Place	Date 1952	Time	Outside temp.	Air temperatures TBCL 1/	TBRS	TCCL	TDCL	TDRS	MCCL	BBCL	BBRS	BCCL	BCRS	BDCL	BDRS	Top air Max.	Min.	Av.	Bottom air Max.	Min.	Av.
			°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.
Madison, Wis.	5-19	7:00P	62	54	47	53	55	57	48	44	53	51	55	55	43	57	47	53.2	55	43	50.2
Madison, Wis.	5-19	7:00P		5,800 pounds old ice remaining in bunkers																	
Madison, Wis.	5-19	10:40P	48	5,800 pounds of crushed ice added to bunkers																	
Madison, Wis.	5-19	11:00P	48	46	44	45	44	47	44	41	44	43	45	45	41	47	44	45.2	45	41	43.2
Madison, Wis.	5-20	7:15A	55	42	42	41	41	43	41	38	40	40	43	41	39	43	41	41.8	43	38	40.2

TRANSIT TEST

Place	Date 1952	Time	Outside temp.	Air temperatures TBCL	BBCL	BDCL	Commodity temperatures TBCL	TCCL	TDCL	TDRS	MCCL	BBCL	BCCL	BCRS	BDCL	Top commodity Max.	Min.	Av.	Bottom commodity Max.	Min.	Av.
			°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.
Madison, Wis.	5-20	8:15A	57	Doors opened, loading started																	
Madison, Wis.	5-20	1:25P		1,000 pounds of salt added to bunker ice																	
Madison, Wis.	5-20	4:00P	66	Loading completed, doors closed																	
Madison, Wis.	5-20	4:10P	66	56	35	46	44	45	57	53	47	41	44	45	44	57	44	49.8	45	41	43.5
Madison, Wis.	5-20	6:20P	53	43	33	38	46	44	40	44	43	36	40	42	38	46	40	43.5	42	36	39.0
Proviso, Ill.	5-21	1:40A	48	40	25	35	46	42	40	43	46	30	34	39	37	46	40	42.8	39	30	35.0
Blue Island, Ill.	5-21	6:00A	49	38	22	32	44	41	39	42	40	27	32	36	35	44	39	41.5	36	27	32.5
Logansport, Ind.	5-21	2:15P	75	40	22	32	42	39	38	40	38	25	30	34	33	42	38	39.8	34	25	30.5
Columbus, Ohio	5-21	9:30P	62	42	25	32	42	40	38	41	37	25	30	31	33	42	38	40.3	33	25	29.8
Columbus, Ohio	5-21	9:30P	62	2,200 pounds of crushed ice and 220 pounds of salt added to bunkers																	
Pitcairn, Pa.	5-22	5:00A	50	39	27	33	43	40	37	41	38	25	31	32	33	43	37	40.3	33	25	30.3
Altoona, Pa.	5-22	9:50A	73	39	27	33	41	39	37	41	40	26	31	32	33	41	37	39.5	33	26	30.5
Enola, Pa.	5-22	4:10P	78	40	29	33	42	39	37	41	40	26	30	32	33	42	37	39.8	33	26	30.3
Philadelphia, Pa.	5-22	11:40P	66	42	30	34	43	40	37	42	39	27	35	33	33	43	37	40.5	35	27	32.0
Philadelphia, Pa.	5-23	7:15A	60	42	31	34	42	40	37	42	39	27	36	32	33	42	37	40.3	36	27	32.0
Philadelphia, Pa.	5-23	7:15A	60	Estimated 10,150 pounds of crushed ice remaining in the bunkers																	
Philadelphia, Pa.	5-23	7:15A	60	Doors opened, unloading started																	
Philadelphia, Pa.	5-23	7:55A		Unloading completed.																	

1/ For explanation of thermometer locations, see page 5.

Table 21.--Temperature of commodity and air as recorded in car N enroute from Madison, Wis., to Philadelphia, Pa., May 19-23, 1952

PRECOOLING TEST

Place	Date 1952	Time	Outside temp.	Air temperatures TBCL 1/	TBRS	TQCL	TDCL	TDRS	MQCL	BBCL	BBRS	BQCL	BQRS	BDCL	BDRS	Top air Max.	Top air Min.	Top air Av.	Bottom air Max.	Bottom air Min.	Bottom air Av.
			°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.
Madison, Wis.	5-19	7:12P	62	50	44	49	49	50	46	43	50	50	50	52	46	50	44	48.4	52	43	48.5
Madison, Wis.	5-19	7:12P	62	5,800 pounds old ice remaining in bunkers																	
Madison, Wis.	5-19	7:12P	62	5,800 pounds crushed ice added to bunkers																	
Madison, Wis.	5-19	11:00P	48	45	40	45	45	46	43	41	46	46	47	45	42	46	40	44.2	47	41	44.5
Madison, Wis.	5-20	7:15A	55	42	37	41	41	44	41	39	42	42	43	42	40	44	37	41.0	43	39	41.3

TRANSIT TEST

Place	Date 1952	Time	Outside temp.	Air temperatures TBCL	BBCL	BDCL	Commodity temperatures TBCL	TQCL	TDCL	TDRS	MQCL	BBCL	BQCL	BQRS	BDCL	Top commodity Max.	Top commodity Min.	Top commodity Av.	Bottom commodity Max.	Bottom commodity Min.	Bottom commodity Av.
			°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.
Madison, Wis.	5-20	8:15A	57	Doore opened, loading started																	
Madison, Wis.	5-20	1:15P		2,000 pounds of salt added to bunker ice																	
Madison, Wis.	5-20	2:00P	66	Loading completed, doors closed																	
Madison, Wis.	5-20	2:00P	66	45	2/	46	46	44	42	41	44	43	43	41	40	46	41	43.3	43	40	41.8
Madison, Wis.	5-20	6:20P	53	43		38	46	44	42	44	44	40	42	40	40	46	42	44.0	42	40	40.5
Proviso, Ill.	5-21	1:40A	48	40		34	44	44	42	47	40	32	36	34	38	47	42	44.3	38	32	35.0
Blue Island, Ill.	5-21	6:00A	49	38		33	42	42	41	48	39	29	33	30	37	48	41	43.3	37	29	32.3
Logansport, Ind.	5-21	2:15P	75	39		33	41	41	40	48	37	27	31	29	35	48	40	42.5	35	27	30.5
Columbus, Ohio	5-21	9:30P	62	42		33	41	41	39	48	36	25	30	28	35	48	39	42.3	35	25	29.5
Columbue, Ohio	5-21	9:30P	62	4,500 pounds of crushed ice and 900 pounds of salt added to bunkers																	
Pitcairn, Pa.	5-22	5:00A	50	40		32	41	40	39	49	36	24	29	28	34	49	39	42.3	34	24	28.8
Altoona, Pa.	5-22	9:50A	73	41		32	40	40	38	52	35	23	28	27	34	52	38	42.5	34	23	28.0
Enola, Pa.	5-22	4:10P	78	41		32	39	39	38	51	34	22	27	27	33	51	38	41.8	33	22	27.3
Philadelphia, Pa.	5-22	11:40P	66	42		32	40	39	38	50	34	23	27	27	33	50	38	41.8	33	23	27.5
Philadelphia, Pa.	5-23	7:15A	60	42		32	40	39	38	50	34	23	27	27	33	50	38	41.8	33	23	27.5
Philadelphia, Pa.	5-23	10:00A		Estimated 8,700 pounds of crushed ice remaining in the bunkere																	
Philadelphia, Pa.	5-23	10:00A		Doors opened, unloading started																	
Philadelphia, Pa.	5-23	11:55A		Unloading completed																	

1/ For explanation of thermometer locations, see page 5.
2/ Thermometer defective.

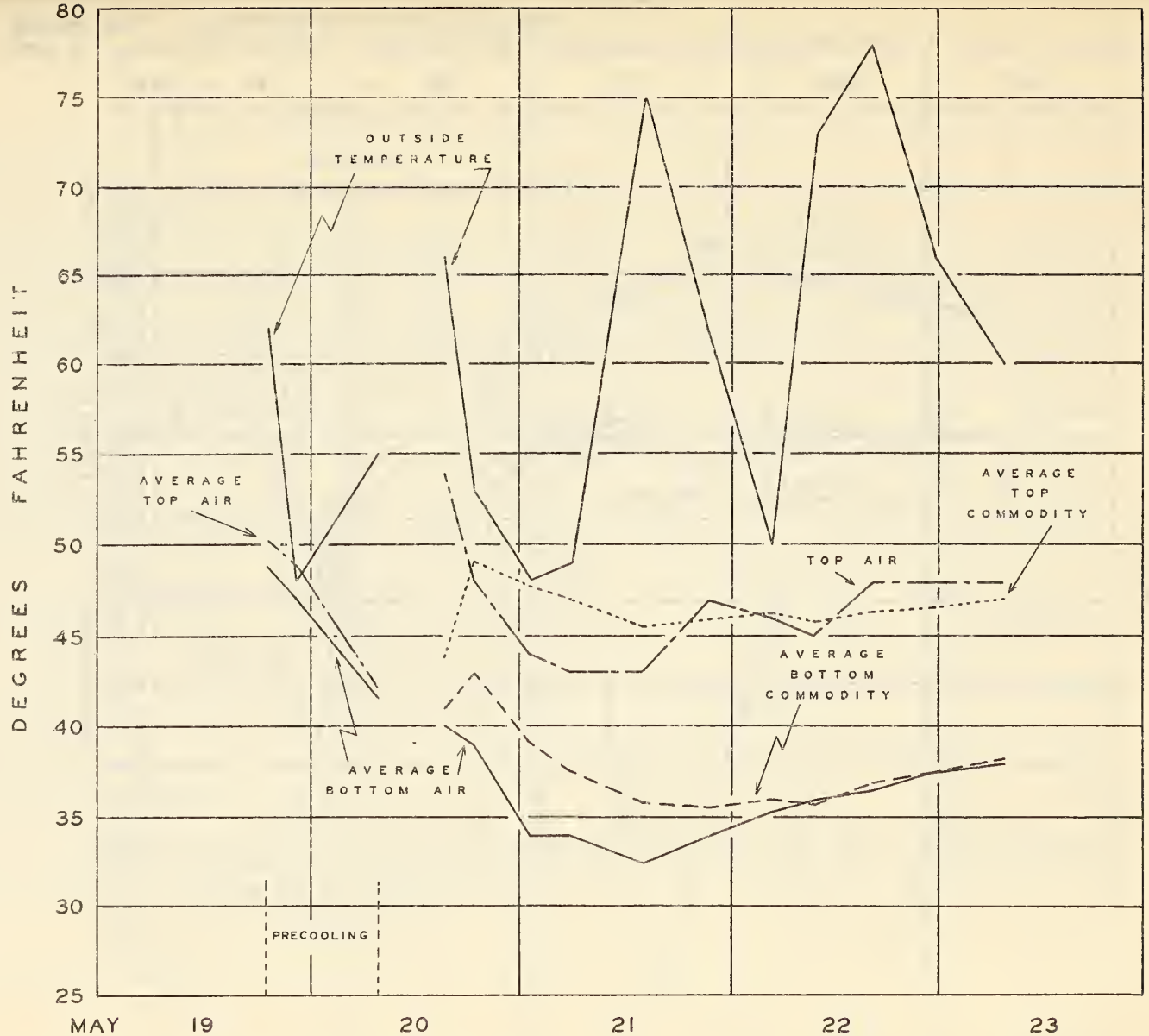


Figure 18.--Precooling and transit temperatures in car L loaded with meat and packinghouse products and shipped from Madison, Wis., to Philadelphia, Pa., May 19-23, 1952.

FIG. #18

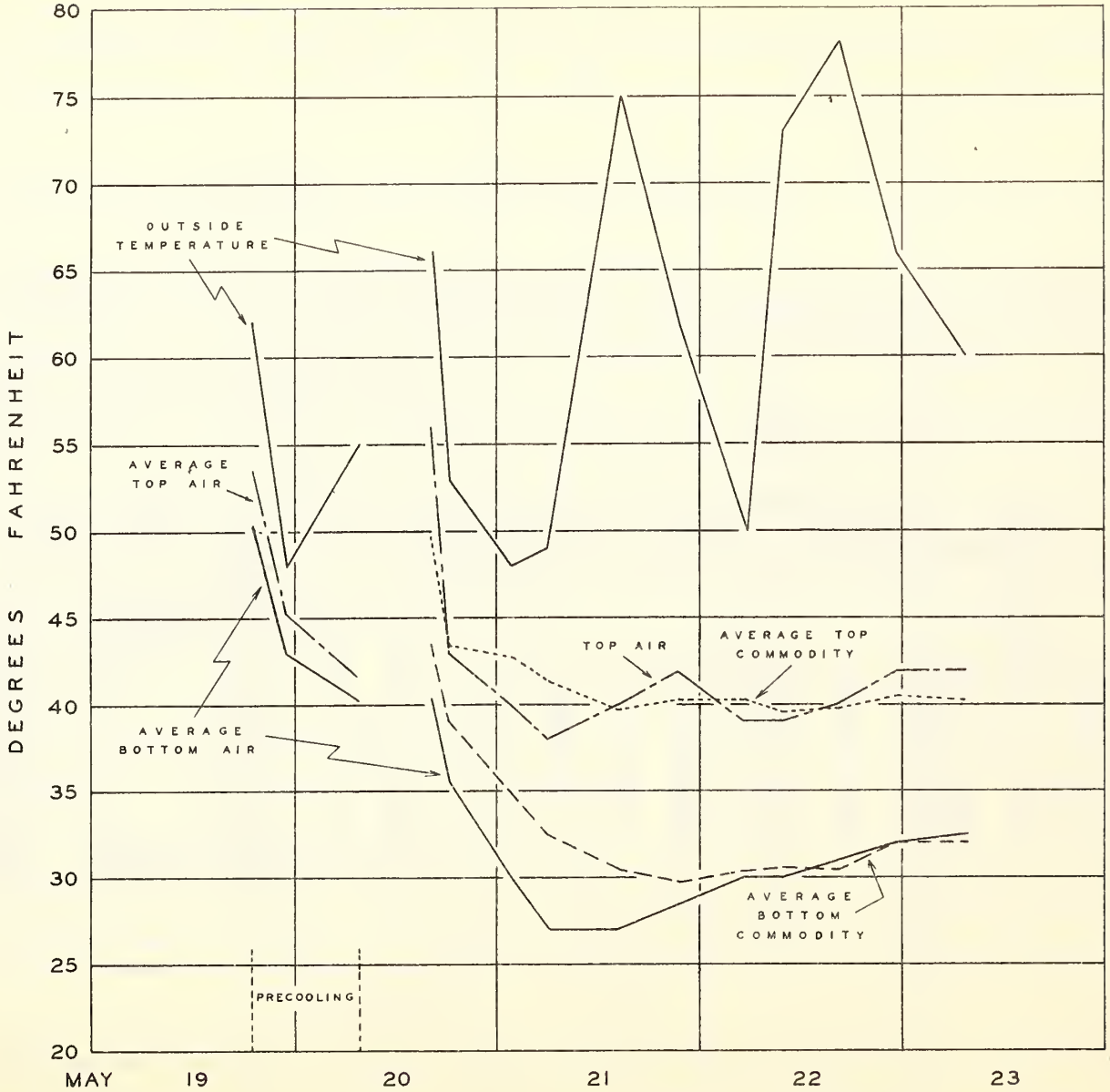


Figure 19.--Precooling and transit temperatures in car M loaded with meat and packinghouse products and shipped from Madison, Wis., to Philadelphia, Pa., May 19-23, 1952.

Fig #11

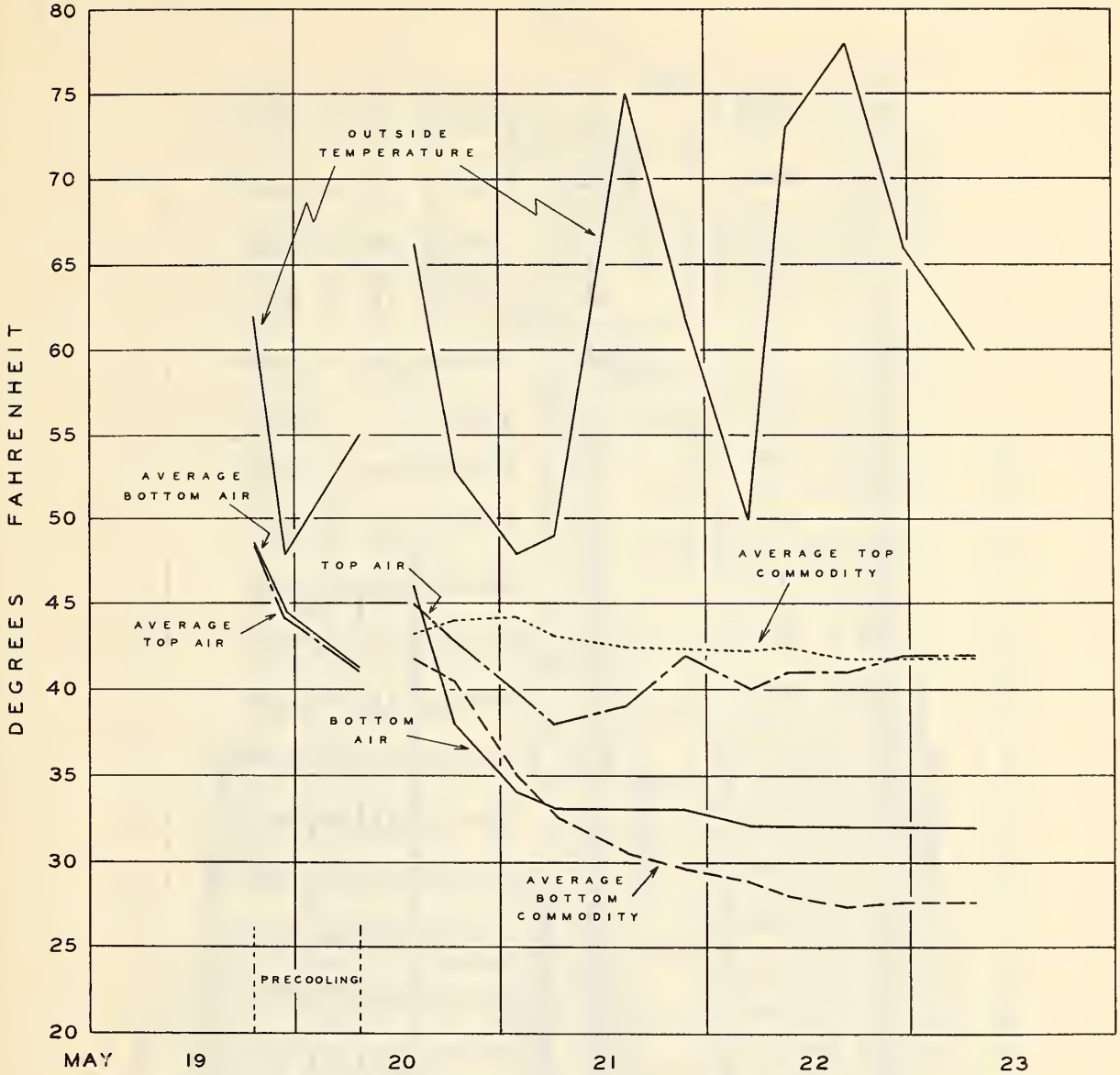


Figure 20.--Precooling and transit temperatures in car N loaded with meat and packinghouse products and shipped from Madison, Wis., to Philadelphia, Pa., May 19-23, 1952.

Table 22.—Temperature of commodity and air as recorded in car O enroute from Austin, Minn., to Brooklyn, N. Y., July 9-14, 1952

PRECOOLING TEST

Place	Date 1952	Time	Outside temp.	Air temperatures TBCL[1]	TQCL	TQRS	TQLS	TDCL	TDLS	BBCL	BQCL	BQRS	BQLS	BDCL	BDLS	Top air Max.	Top air Min.	Top air Av.	Bottom air Max.	Bottom air Min.	Bottom air Av.
			°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.
Austin, Minn.	7- 9	2:00P	83	72	70	71	71	72	71	69	71	71	71	72	72	72	70	71.2	72	69	71.0
Austin, Minn.	7- 9	2:12P		Initially iced with 9,500 pounds of crushed ice																	
Austin, Minn.	7- 9	5:00P	83	50	56	56	55	58	57	40	49	47	45	49	49	58	50	55.3	49	40	46.5
Austin, Minn.	7- 9	8:00P	73	45	50	50	50	52	52	37	45	43	42	45	44	52	45	49.8	45	37	42.7
Austin, Minn.	7- 9	11:00P	68	43	48	49	48	50	50	37	44	42	41	44	44	50	43	48.0	44	37	42.0
Austin, Minn.	7-10	4:00A	62	41	44	46	40	46	46	36	41	40	39	42	41	46	40	43.8	42	36	39.8
Austin, Minn.	7-10	6:35A		1,500 pounds of crushed ice added to bunkers																	
Austin, Minn.	7-10	8:00A	71	40	44	44	44	45	45	36	41	40	40	42	41	45	40	43.7	41	36	40.0

TRANSIT TEST

Place	Date 1952	Time	Outside temp.	Air temperatures TBCL	BBCL	BDCL	Commodity temperatures TBCL	TQCL	TDCL	TDRS	MQCL	BBCL	BQCL	BQRS	BDCL	Top commodity Max.	Top commodity Min.	Top commodity Av.	Bottom commodity Max.	Bottom commodity Min.	Bottom commodity Av.
			°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.
Austin, Minn.	7-10	9:30A		Doors opened, loading started																	
Austin, Minn.	7-10	11:00A		Loading completed, doors closed																	
Austin, Minn.	7-10	11:30A	78	51	36	40	45	43	42	40	41	38	38	38	40	45	40	42.5	40	38	38.5
Austin, Minn.	7-10	8:00P	78	45	34	31	44	43	41	41	40	38	37	37	37	44	41	42.3	38	37	37.3
Postville, Iowa	7-11	12:30A	72	44	34	30	42	42	40	40	40	37	36	36	37	42	40	41.0	37	36	36.5
Dubuque, Iowa	7-11	5:30A	72	43	35	31	42	42	41	38	40	39	37	38	37	42	38	40.8	39	37	37.8
Savanna, Ill.	7-11	8:00A	79	43	34	31	42	41	40	38	40	38	37	38	37	42	38	40.3	38	37	37.5
Blue Island, Ill.	7-11	4:00P	90	43	34	34	42	41	39	37	39	38	38	38	37	42	37	39.8	38	37	37.8
Blue Island, Ill.	7-11	4:30P	90	2,000 pounds of crushed ice and 200 pounds of salt added to bunkere																	
Dolton, Ill.	7-11	8:30P	80	44	29	32	43	42	40	38	40	38	38	32	37	43	38	40.8	38	32	36.3
Columbus, Ohio	7-12	6:30A	76	41	25	33	40	40	38	37	38	37	38	30	36	40	37	38.8	38	30	35.3
Columbus, Ohio	7-12	7:45A	78	900 pounds of crushed ice and 90 pounds of salt added to bunkers																	
Pitcairn, Pa.	7-12	1:25P	95	41	26	33	40	40	38	35	34	37	31	29	34	40	35	38.3	37	29	32.8
Huntingdon, Pa.	7-12	5:55P	95	41	25	33	40	39	37	34	33	36	31	29	34	40	34	37.5	36	29	32.5
Huntingdon, Pa.	7-12	6:20P	95	700 pounds of crushed ice and 70 pounds of salt added to bunkers																	
Harrisburg, Pa.	7-12	9:15P	77	41	25	34	40	40	38	35	33	37	31	28	34	40	35	38.3	37	28	32.5
Brooklyn, N. Y.	7-13	8:45A	87	40	27	33	39	39	37	34	32	35	31	27	33	39	34	37.3	35	27	31.5
Brooklyn, N. Y.	7-13	4:00P	95	43	28	33	41	40	37	34	33	35	32	29	33	41	34	38.0	35	29	32.3
Brooklyn, N. Y.	7-14	12:01A	83	45	30	36	42	42	38	36	34	36	34	32	34	42	36	39.5	36	32	34.0
Brooklyn, N. Y.	7-14	12:15A		Estimated 8,190 pounds of crushed ice remaining																	
Brooklyn, N. Y.	7-14	3:30A		Doors opened, unloading started																	
Brooklyn, N. Y.	7-14	6:00A		Unloading completed																	

1/ For explanation of thermometer locatione, see page 5.

Table 23.—Temperature of commodity and air as recorded in car Q enroute from Austin, Minn., to Brooklyn, N. Y., July 9-14, 1952

PRECOOLING TEST

Place	Date 1952	Time	Outside temp.	Air temperatures TBCL 1/	TQCL	TQRS	TQLS	TDCL	TDLS	BBCL	BQCL	BQRS	BQLS	BDCL	BDLS	Top air Max.	Top air Min.	Top air Av.	Bottom air Max.	Bottom air Min.	Bottom air Av.
			°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.
Austin, Minn.	7- 9	2:00P	83	73	72	71	72	72	72	72	71	72	72	72	2/	73	71	72.0	72	71	71.8
Austin, Minn.	7- 9	2:10P		Initially iced with 9,500 pounds of crushed ice and 950 pounds of salt																	
Austin, Minn.	7- 9	5:00P	83	51	49	49	50	49	50	28	42	44	44	43		51	49	49.7	44	28	40.2
Austin, Minn.	7- 9	8:00P	73	46	42	42	43	43	43	24	37	38	38	37		46	42	43.2	38	24	34.8
Austin, Minn.	7- 9	11:00P	68	42	39	39	40	39	40	23	32	34	34	34		42	39	39.8	34	23	31.4
Austin, Minn.	7-10	4:00A	62	38	35	35	36	35	36	22	30	31	31	31		38	35	35.8	31	22	29.0
Austin, Minn.	7-10	6:30A		2,000 pounds of crushed ice and 200 pounds of salt added to bunkers																	
Austin, Minn.	7-10	8:00A	71	36	34	34	35	34	35	23	30	31	30	31		36	34	34.7	31	23	29.0

TRANSIT TEST

Place	Date 1952	Time	Outside temp.	Air temperatures TBCL	BBCL	BDCL	Commodity temperatures TBCL	TQCL	TDCL	TDRS	MQCL	BBCL	BQCL	BQRS	BDCL	Top commodity Max.	Top commodity Min.	Top commodity Av.	Bottom commodity Max.	Bottom commodity Min.	Bottom commodity Av.
			°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.
Austin, Minn.	7-10	9:20A		Doors opened, loading started																	
Austin, Minn.	7-10	10:45A		Loading completed, doors closed																	
Austin, Minn.	7-10	11:00A	78	48	27	34	41	36	32	44	2/	34	40	49	30	44	32	38.3	49	30	38.3
Austin, Minn.	7-10	8:00P	78	44	28	32	42	38	32	42		31	40	42	30	42	32	38.5	42	30	35.8
Postville, Iowa	7-11	12:30A	72	45	30	34	43	40	33	43		32	40	41	30	43	33	39.8	41	30	35.8
Dubuque, Iowa	7-11	5:30A	72	44	31	34	43	39	32	41		31	39	40	30	43	32	38.8	40	30	35.0
Savanna, Ill.	7-11	8:00A	79	45	31	34	43	40	32	42		31	38	40	30	43	32	39.3	40	30	34.8
Blue Island, Ill.	7-11	4:00P	90	48	32	35	43	40	34	42		32	38	40	30	43	34	39.8	40	30	35.0
Blue Island, Ill.	7-11	4:35P	90	2,200 pounds of crushed ice and 220 pounds of salt added to bunkers																	
Dolton, Ill.	7-11	8:30P	80	47	29	35	43	41	34	42		30	37	40	30	43	34	40.0	40	30	34.3
Columbus, Ohio	7-12	6:30A	76	43	27	34	43	41	34	40		30	37	39	30	43	34	39.5	39	30	34.0
Columbus, Ohio	7-12	7:48A	78	1,300 pounds of crushed ice and 130 pounds of salt added to bunkers																	
Pitcairn, Pa.	7-12	1:25P	95	43	27	33	42	41	34	40		29	36	39	30	42	34	39.3	39	29	33.5
Huntingdon, Pa.	7-12	5:55P	95	44	27	35	43	40	34	40		29	36	38	30	43	34	39.3	38	29	33.3
Huntingdon, Pa.	7-12	6:25P	95	1,400 pounds of crushed ice and 140 pounds of salt added to bunkers																	
Harrisburg, Pa.	7-12	9:15P	77	44	28	35	42	40	34	40		30	35	38	30	42	34	39.0	38	30	33.3
Brooklyn, N. Y.	7-13	8:45A	87	43	26	34	41	40	34	39		29	34	37	30	41	34	38.5	37	29	32.5
Brooklyn, N. Y.	7-13	4:00P	95	46	27	32	41	39	35	39		29	34	36	30	41	35	38.5	36	29	32.3
Brooklyn, N. Y.	7-14	12:01A	83	48	30	34	42	40	36	40		29	33	36	30	42	36	39.5	36	29	32.0
Brooklyn, N. Y.	7-14	12:15A	83	Estimated 7,962 pounds of crushed ice remaining																	
Brooklyn, N. Y.	7-14	3:00A		Doors opened, unloading started																	
Brooklyn, N. Y.	7-14	6:00A		Unloading completed																	

1/ For explanation of thermometer locations, see page 5.
2/ Thermometer defective.

Table 24.—Temperature of commodity and air as recorded in car R enroute from Austin, Minn., to Brooklyn, N. Y., July 9-14, 1952

PRECOOLING TEST

Place	Date 1952	Time	Outside temp.	Air temperatures TBCL 1/	TQCL	TQRS	TQLS	TDCL	TDLS	BBCL	BQCL	BQRS	BQLS	BDCL	BDLS	Top air Max.	Top air Min.	Top air Av.	Bottom air Max.	Bottom air Min.	Bottom air Av.
			°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.
Austin, Minn.	7- 9	2:00P	83	74	74	74	74	74	2/	72	77	74	74	74	73	74	74	74.0	77	72	74.0
Austin, Minn.	7- 9	2:10P		Initially iced with 9,500 pounds of crushed ice																	
Austin, Minn.	7- 9	5:00P	83	57	55	51	56	56		42	60	51	51	51	50	57	51	55.0	60	42	50.8
Austin, Minn.	7- 9	8:00P	73	53	51	48	51	52		40	56	47	48	47	46	53	48	51.0	56	40	47.3
Austin, Minn.	7- 9	11:00P	68	51	49	46	49	49		39	53	45	46	45	44	51	46	48.8	53	39	45.3
Austin, Minn.	7-10	4:00A	62	47	45	44	46	45		37	50	43	43	43	42	47	44	45.4	50	37	43.0
Austin, Minn.	7-10	6:48A		1,500 pounds of crushed ice added to bunkers																	
Austin, Minn.	7-10	8:00A	71	47	45	43	46	46		37	50	43	44	44	42	47	43	45.4	50	37	43.3

TRANSIT TEST

Place	Date 1952	Time	Outside temp.	Air temperatures TBCL	BBCL	BDCL	Commodity temperatures TBCL	TQCL	TDCL	TDRS	MQCL	BBCL	BQCL	BQRS	BDCL	Top commodity Max.	Top commodity Min.	Top commodity Av.	Bottom commodity Max.	Bottom commodity Min.	Bottom commodity Av.
			°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.
Austin, Minn.	7-10	10:00A		Doors opened, loading started																	
Austin, Minn.	7-10	3:40P		Loading completed, doors closed																	
Austin, Minn.	7-10	3:45P	54 3/	49	37	31	50	24	21	2/	39	46	32	49	17	50	21	31.7	49	17	36.0
Austin, Minn.	7-10	8:00P	78	44	36	19	48	27	27		35	43	33	45	15	48	27	34.0	45	15	34.0
Postville, Iowa	7-10	11:30P	72	43	36	19	47	28	28		33	42	34	43	16	47	28	34.3	43	16	33.8
Dubuque, Iowa	7-11	5:30A	72	41	35	19	46	29	29		31	41	33	40	17	46	29	34.7	41	17	32.8
Savanna, Ill.	7-11	8:00A	79	42	36	22	46	30	30		31	41	33	40	18	46	30	35.3	41	18	33.0
Blue Island, Ill.	7-11	4:00P	90	45	38	20	46	31	31		30	41	33	39	18	46	31	36.0	41	18	32.8
Blue Island, Ill.	7-11	4:30P	90	1,200 pounds of crushed ice and 120 pounds of salt added to bunkers																	
Dolton, Ill.	7-11	8:30P	80	42	31	19	45	31	31		30	39	32	39	18	45	31	35.7	39	18	32.0
Columbus, Ohio	7-12	6:30A	76	40	2/	20	42	31	30		30	35	32	40	20	42	30	34.3	40	20	31.8
Columbus, Ohio	7-12	7:42A	78	800 pounds of crushed ice and 80 pounds of salt added to bunkers																	
Pitcairn, Pa.	7-12	1:25P	95	39		24	41	31	30		29	33	32	40	20	41	30	34.0	40	20	31.3
Huntingdon, Pa.	7-12	5:55P	95	41		24	41	31	30		29	33	32	41	20	41	30	34.0	41	20	31.5
Huntingdon, Pa.	7-12	6:15P	95	500 pounds of crushed ice and 50 pounds of salt added to bunkers																	
Harrisburg, Pa.	7-12	9:15P	77	40		25	41	31	30		29	32	32	41	21	41	30	34.0	41	21	31.5
Brooklyn, N. Y.	7-13	7:30A	92	44		26	41	32	30		29	32	32	43	23	41	30	34.3	43	23	32.5
Brooklyn, N. Y.	7-13	11:30P	90	44		26	42	33	30		30	32	32	44	23	42	30	35.0	44	23	32.8
Brooklyn, N. Y.	7-14	12:15A	83	Estimated 7,962 pounds of crushed ice remaining																	
Brooklyn, N. Y.	7-14	2:00A		Doors opened, unloading started																	
Brooklyn, N. Y.	7-14	4:30A		Unloading completed																	

1/ For explanation of thermometer locations, see page 5.
2/ Thermometer defective.
3/ This car under enclosed shed during loading.

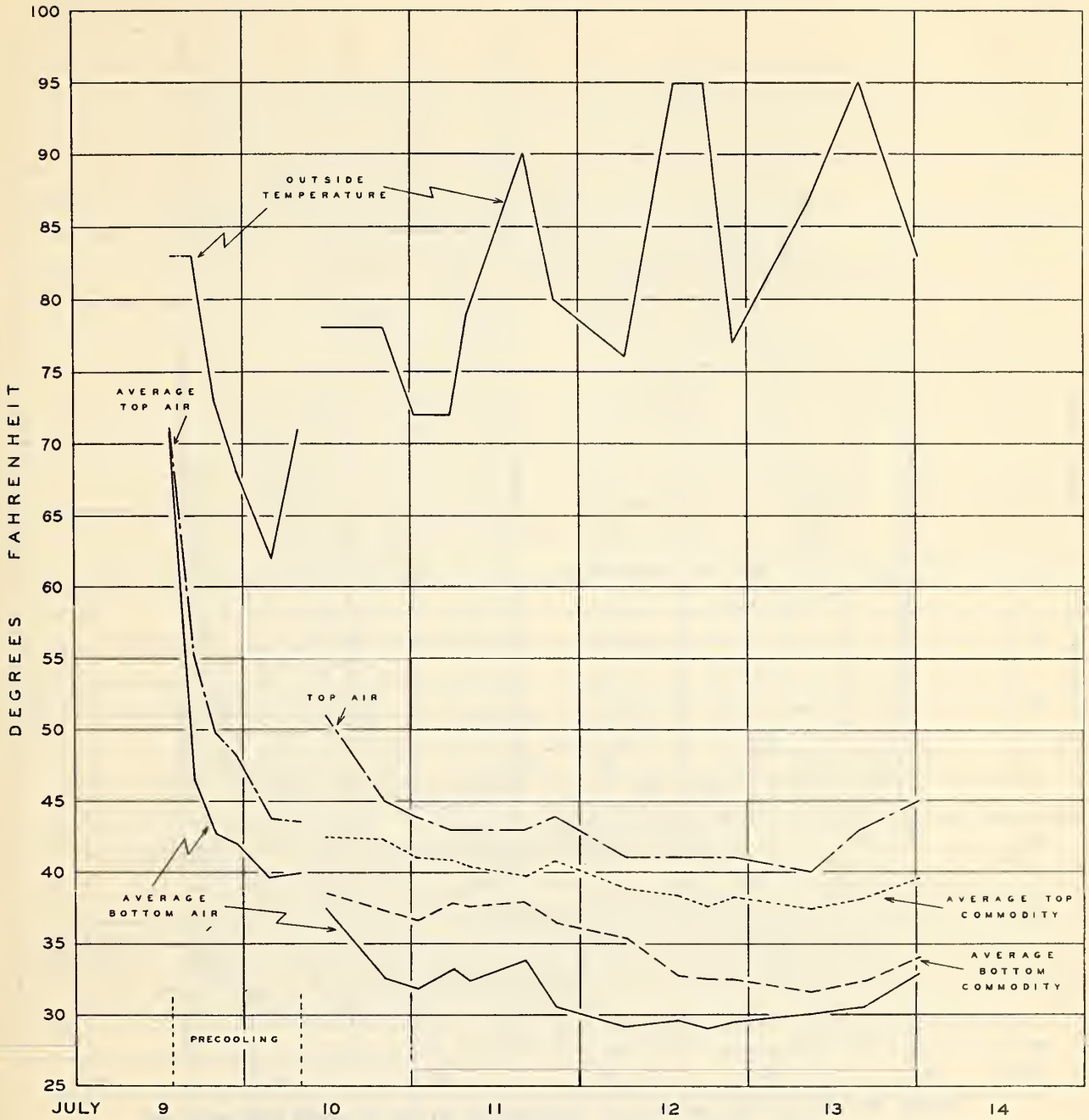


Figure 21.--Precooling and transit temperatures in car O loaded with meat and packinghouse products and shipped from Austin, Minn., to Brooklyn, N. Y., July 9-14, 1952.

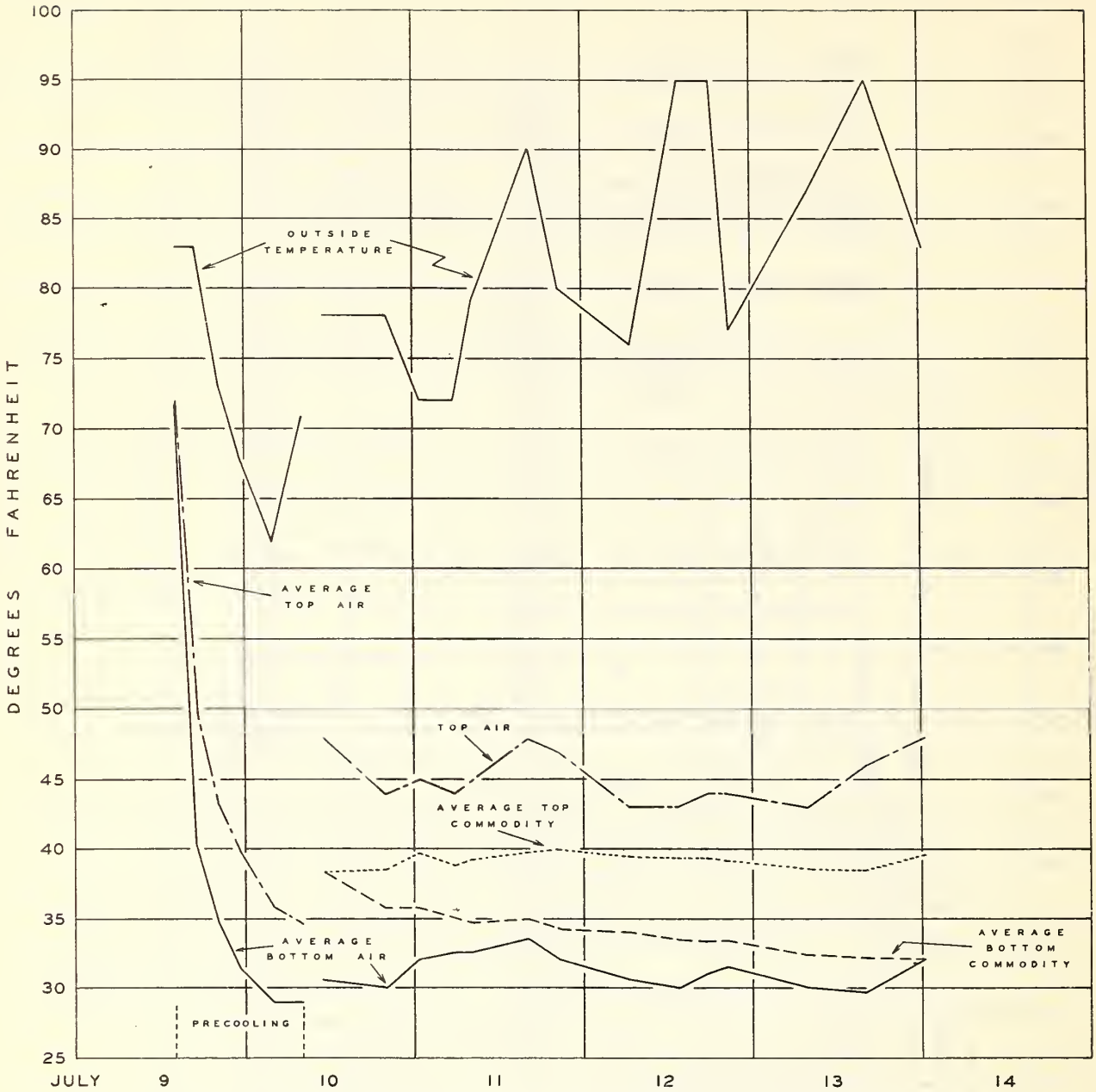


Figure 22.--Precooling and transit temperatures in car Q loaded with meat and packinghouse products and shipped from Austin, Minn., to Brooklyn, N. Y., July 9-14, 1952.

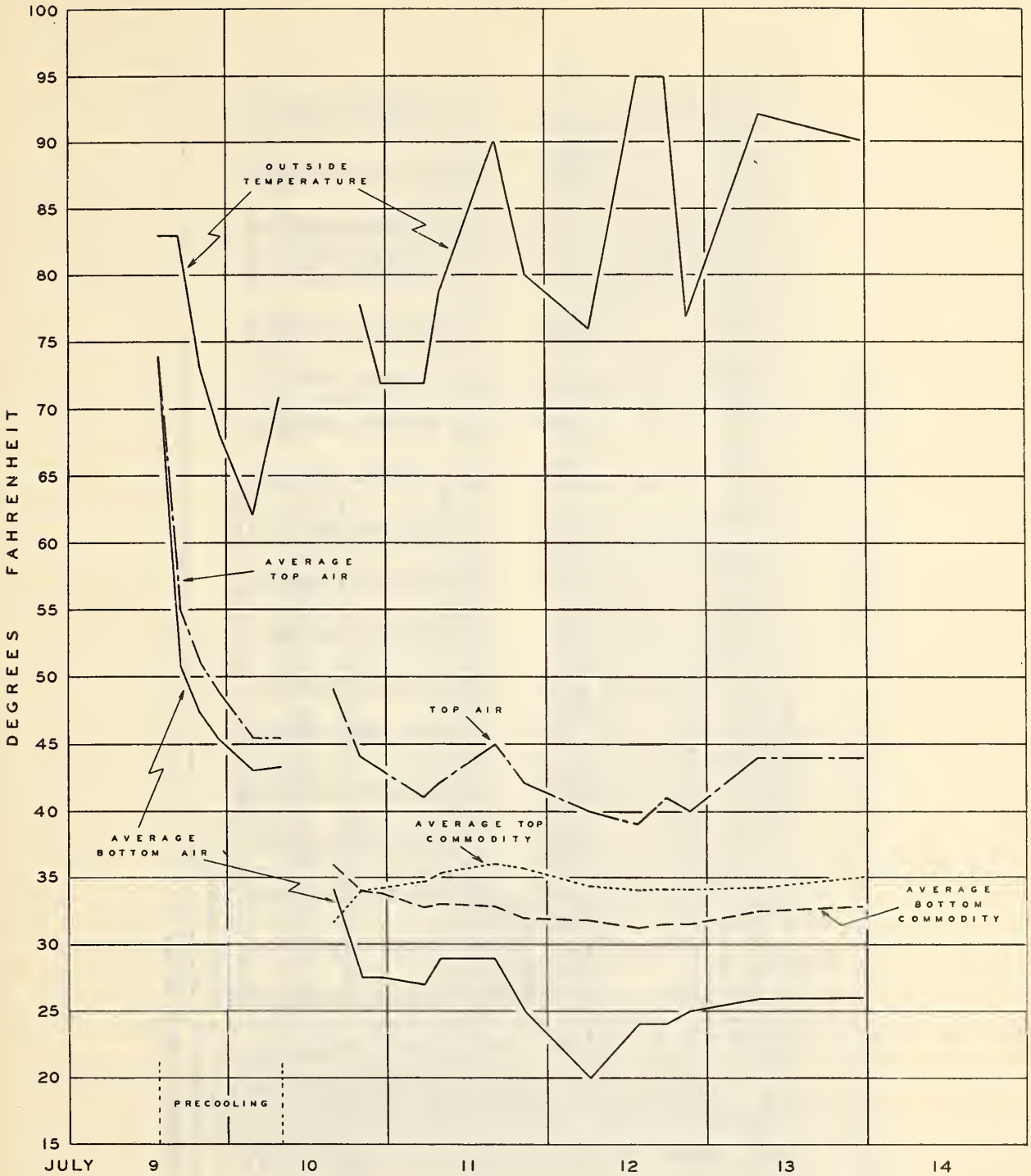


Figure 23.--Precooling and transit temperatures in car R loaded with meat and packinghouse products and shipped from Austin, Minn., to Brooklyn, N. Y., July 9-14, 1952.

Table 25.--Temperature of commodity and air as recorded in car S enroute from Madison, Wis., to Philadelphia, Pa., August 19-23, 1952

PRECOOLING TEST

Place	Date 1952	Time	Outside temp.	Air temperatures TBCL 1/	TBRS	TQCL	TDCL	TDRS	MQCL	BBCL	BBRS	BQCL	BQRS	BDCL	BDRS	Top air Max.	Min.	Av.	Bottom air Max.	Min.	Av.
			°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.
Madison, Wis.	8-19	6:00P	70	72	71	71	72	73	70	71	72	70	70	72	70	73	71	71.8	72	70	70.8
Madison, Wis.	8-19	7:40P	70	Initially iced with 8000 pounds of crushed ice																	
Madison, Wis.	8-20	6:45A	68	49	48	49	53	44	48	38	50	42	46	51	45	53	44	48.6	51	38	45.3

TRANSIT TEST

Place	Date 1952	Time	Outside temp.	Air temperatures TBCL	BBCL	BDCL	Commodity temperatures TBCL	TQCL	TDCL	TDRS	MQCL	BBCL	BQCL	BQRS	BDCL	Top commodity Max.	Min.	Av.	Bottom commodity Max.	Min.	Av.
			°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.
Madison, Wis.	8-20	8:30A	70	Doors opened																	
Madison, Wis.	8-20	8:50A	70	Loading started																	
Madison, Wis.	8-20	11:00A	72	Loading completed																	
Madison, Wis.	8-20	1:00P	72	600 pounds of dry ice suspended over the load, doors closed																	
Madison, Wis.	8-20	2:00P	73	62	37	40	41	44	41	32	31	30	35	34	37	44	32	39.5	37	30	34.0
Madison, Wis.	8-20	4:55P	70	300 pounds of crushed ice and 1,500 pounds of salt added to the bunkers																	
Madison, Wis.	8-20	5:00P	70	47	36	38	40	42	39	35	31	31	35	35	37	42	35	39.0	37	31	34.5
Madison, Wis.	8-20	8:00P	73	43	26	37	38	41	39	36	32	31	35	36	37	41	36	38.5	37	31	34.8
Proviso, Ill.	8-21	2:00A	70	38	13	24	35	39	37	35	30	27	30	33	30	39	35	36.5	33	27	30.0
Blue Island, Ill.	8-21	7:30A	72	35	11	23	35	37	35	34	29	26	28	30	29	37	34	35.3	30	26	28.3
Logansport, Ind.	8-21	2:45P	82	39	13	28	34	36	34	33	28	25	26	29	28	36	33	34.3	29	25	27.0
Columbus, Ohio	8-21	11:00P	73	46	25	34	36	37	37	34	29	25	29	29	30	37	34	36.0	30	25	28.3
Columbus, Ohio	8-21	11:55P	73	3,200 pounds of crushed ice and 480 pounds of salt added to the bunkers																	
Pitcairn, Pa.	8-22	7:30A	67	36	15	27	34	35	34	33	29	24	26	28	29	35	33	34.0	29	24	26.8
Altoona, Pa.	8-22	12:45P	75	35	14	25	33	33	33	32	29	23	27	27	28	33	32	32.8	28	23	26.3
Huntingdon, Pa.	8-22	3:35P	79	1,200 pounds of crushed ice and 180 pounds of salt added to the bunkers																	
Enola, Pa.	8-22	6:00P	70	36	15	26	34	34	34	32	30	22	25	26	28	34	32	33.5	28	22	25.3
Enola, Pa.	8-22	11:00P	62	36	16	29	33	34	31	32	28	23	25	27	28	34	31	32.5	28	23	25.8
Philadelphia, Pa.	8-23	6:00A	59	35	17	28	32	33	31	32	28	21	25	27	28	33	31	32.0	28	21	25.3
Philadelphia, Pa.	8-23	7:15A	60	Estimated 7,100 pounds of crushed ice and 10 pounds of dry ice remaining																	
Philadelphia, Pa.	8-23	8:10A	60	Doors opened for unloading																	
Philadelphia, Pa.	8-23	10:30A	60	Unloading completed																	

1/ For explanation of thermometer locations, see page 5.

Table 26.—Temperature of commodity and air as recorded in car T enroute from Madison, Wis., to Philadelphia, Pa., August 19-23, 1952

PRECOOLING TEST

Place	Date 1952	Time	Outside temp.	Air temperatures TBCL 1/	TBRS	TQCL	TDCL	TDRS	MQCL	BBCL	BBRS	BQCL	BQRS	BDCL	BDRS	Top air Max.	Min.	Av.	Bottom air Max.	Min.	Av.
			°F	°F	°F	°F	°F	°F	°F	°F	°F	°F	°F	°F	°F	°F	°F	°F	°F	°F	°F
Madison, Wis.	8-19	6:00P	70	71	71	72	71	71	72	70	70	70	71	70	70	72	71	71.2	71	70	70.2
Madison, Wis.	8-19	7:45P	70	Initially load with 8,000 pounds of crushed ice																	
Madison, Wis.	8-20	6:45A	68	48	49	53	52	2/	48	40	48	46	42	52	44	53	48	50.5	52	40	45.3

TRANSIT TEST

Place	Date 1952	Time	Outside temp.	Air temperatures TBCL	BBCL	BDCL	Commodity temperatures TBCL	TQCL	TDCL	TDRS	MQCL	BBCL	BQCL	BQRS	BDCL	Top commodity Max.	Min.	Av.	Bottom commodity Max.	Min.	Av.
			°F	°F	°F	°F	°F	°F	°F	°F	°F	°F	°F	°F	°F	°F	°F	°F	°F	°F	°F
Madison, Wis.	8-20	8:30A		Doors opened																	
Madison, Wis.	8-20	9:45A		Loading started																	
Madison, Wis.	8-20	3:15P		1,200 pounds of dry ice suspended over the load																	
Madison, Wis.	8-20	3:20P		Loading completed, doors closed																	
Madison, Wis.	8-20	4:45P		100 pounds of crushed ice and 1,500 pounds of salt added to bunkers																	
Madison, Wis.	8-20	5:00P	70	46	39	38	47	46	35	35	36	34	37	35	2/	47	35	40.8	37	34	35.3
Madison, Wis.	8-20	8:00P	73	35	38	34	45	45	35	35	36	35	37	35		45	35	40.0	37	35	35.7
Proviso, Ill.	8-21	2:00A	70	36	33	30	40	41	32	34	34	33	35	35		41	32	36.8	35	33	34.3
Blue Island, Ill.	8-21	7:30A	72	35	-	28	39	40	31	33	33	31	35	34		40	31	35.8	35	31	33.3
Logansport, Ind.	8-21	2:45P	82	37	28	28	36	37	30	32	32	27	33	31		37	30	33.8	33	27	30.3
Columbus, Ohio	8-21	11:00P	73	41	24	29	37	38	31	34	32	29	33	32		38	31	35.0	33	29	31.3
Columbus, Ohio	8-21	11:55P	73	2,800 pounds of crushed ice and 420 pounds of salt added to bunkers																	
Pitcairn, Pa.	8-22	7:30A	67	34	17	29	36	37	32	34	32	27	33	32		37	32	34.8	33	27	30.7
Altoona, Pa.	8-22	12:40P	75	33	17	29	35	36	32	32	32	25	33	30		36	32	33.8	33	25	29.3
Huntingdon, Pa.	8-22	3:30P	79	900 pounds of crushed ice and 135 pounds of salt added to bunkers																	
Enola, Pa.	8-22	6:00P	70	34	17	29	34	35	31	34	31	23	34	29		35	31	33.5	34	23	28.7
Enola, Pa.	8-22	11:00P	62	33	17	29	37	35	31	34	30	23	32	27		37	31	34.3	32	23	27.3
Philadelphia, Pa.	8-23	6:00A	59	32	17	27	34	34	30	32	29	23	30	25		34	30	32.5	30	23	26.0
Philadelphia, Pa.	8-23	7:00A	60	Estimated 7,100 pounds of crushed ice and 50 pounds of dry ice remaining																	
Philadelphia, Pa.	8-23	8:15A	60	Doors opened, unloading started																	
Philadelphia, Pa.	8-23	10:30A	60	Unloading completed																	

1/ For explanation of thermometer locations, see page 5.
2/ Thermometer defective.

Table 27.—Temperature of commodity and air as recorded in car U enroute from Madison, Wis., to Philadelphia, Pa., August 19-23, 1952

PRECOOLING TEST

Place	Date 1952	Time	Outside temp.	Air temperatures TBCL 1/	TBRS	TQCL	TDCL	TDRS	MQCL	BBCL	BBRS	BQCL	BQRS	BDCL	BDRS	Top air Max.	Min.	Av.	Bottom air Max.	Min.	Av.
			°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.
Madison, Wis.	8-19	6:00P	70	71	71	72	71	71	72	70	70	72	71	70	70	72	71	71.2	72	70	70.5
Madison, Wis.	8-19	7:35P	70	Initially iced with 11,000 pounds of crushed ice																	
Madison, Wis.	8-20	6:45A	68	49	48	45	47	46	50	39	46	50	50	46	47	49	45	47.0	50	39	46.3

TRANSIT TEST

Place	Date 1952	Time	Outside temp.	Air temperatures TBCL	BBCL	BDCL	Commodity temperatures TBCL	TQCL	TDCL	TDRS	MQCL	BBCL	BQCL	BQRS	BDCL	Top commodity Max.	Min.	Av.	Bottom commodity Max.	Min.	Av.
			°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.
Madison, Wis.	8-20	8:30A	70	Doors opened																	
Madison, Wis.	8-20	10:15A	72	Loading started																	
Madison, Wis.	8-20	1:30P	72	2,000 pounds of salt added to bunkers																	
Madison, Wis.	8-20	1:45P	72	Loading completed, doors closed																	
Madison, Wis.	8-20	1:50P	73	68	35	64	47	49	46	40	34	41	34	32	34	49	40	45.5	41	32	35.3
Madison, Wis.	8-20	2:00P	73	Precooling motors started																	
Madison, Wis.	8-20	3:00P	73	24	39	36	47	37	41	39	33	41	33	34	34	47	37	41.0	41	33	35.5
Madison, Wis.	8-20	4:00P	71	18	32	27	44	32	36	39	30	38	30	31	30	44	32	37.8	38	30	32.3
Madison, Wis.	8-20	4:55P	70	1,700 pounds of crushed ice added to bunkers																	
Madison, Wis.	8-20	5:00P	70	21	35	31	46	35	39	39	32	40	32	33	33	46	35	39.8	40	32	34.5
Madison, Wis.	8-20	5:01P	70	Precooling motors stopped																	
Madison, Wis.	8-20	8:00P	73	39	16	40	43	37	37	38	31	35	31	32	31	43	37	38.8	35	31	32.3
Proviso, Ill.	8-21	2:00A	70	34	17	27	40	32	32	35	29	30	29	29	28	40	32	34.8	30	28	29.0
Blue Island, Ill.	8-21	7:30A	72	38	10	25	37	31	32	31	28	25	28	28	27	37	31	32.8	28	25	27.0
Logansport, Ind.	8-21	2:45P	82	29	25	26	35	27	29	30	27	24	27	27	25	35	27	30.3	27	24	25.8
Columbus, Ohio	8-21	11:00P	73	33	28	21	34	28	30	21	27	26	27	28	27	34	21	28.3	28	26	27.0
Columbus, Ohio	8-21	11:55P	73	5,000 pounds of crushed ice and 1,000 pounds of salt added to bunkers																	
Pittsburg, Pa.	8-22	7:30A	67	27	22	20	30	22	25	20	22	23	22	25	23	30	20	24.3	25	22	23.3
Altoona, Pa.	8-22	12:40P	75	23	28	20	29	24	25	22	22	22	22	24	23	29	22	25.0	24	22	22.8
Huntingdon, Pa.	8-22	3:35P	79	2,800 pounds of crushed ice and 560 pounds of salt added to bunkers																	
Enola, Pa.	8-22	6:00P	70	26	26	20	27	23	24	24	22	21	22	24	22	27	23	24.5	24	21	22.3
Enola, Pa.	8-22	11:00P	62	34	12	22	28	26	27	27	23	24	23	24	22	28	26	27.0	24	22	23.3
Philadelphia, Pa.	8-23	6:00A	59	31	16	23	27	25	26	27	22	23	22	23	22	27	25	26.3	23	22	22.5
Philadelphia, Pa.	8-23	7:15A	60	Estimated 9,000 pounds of crushed ice remaining																	
Philadelphia, Pa.	8-23	10:15A	60	Doors opened, unloading started																	
Philadelphia, Pa.	8-23	11:45A		Unloading completed																	

1/ For explanation of thermometer locations, see page 5.

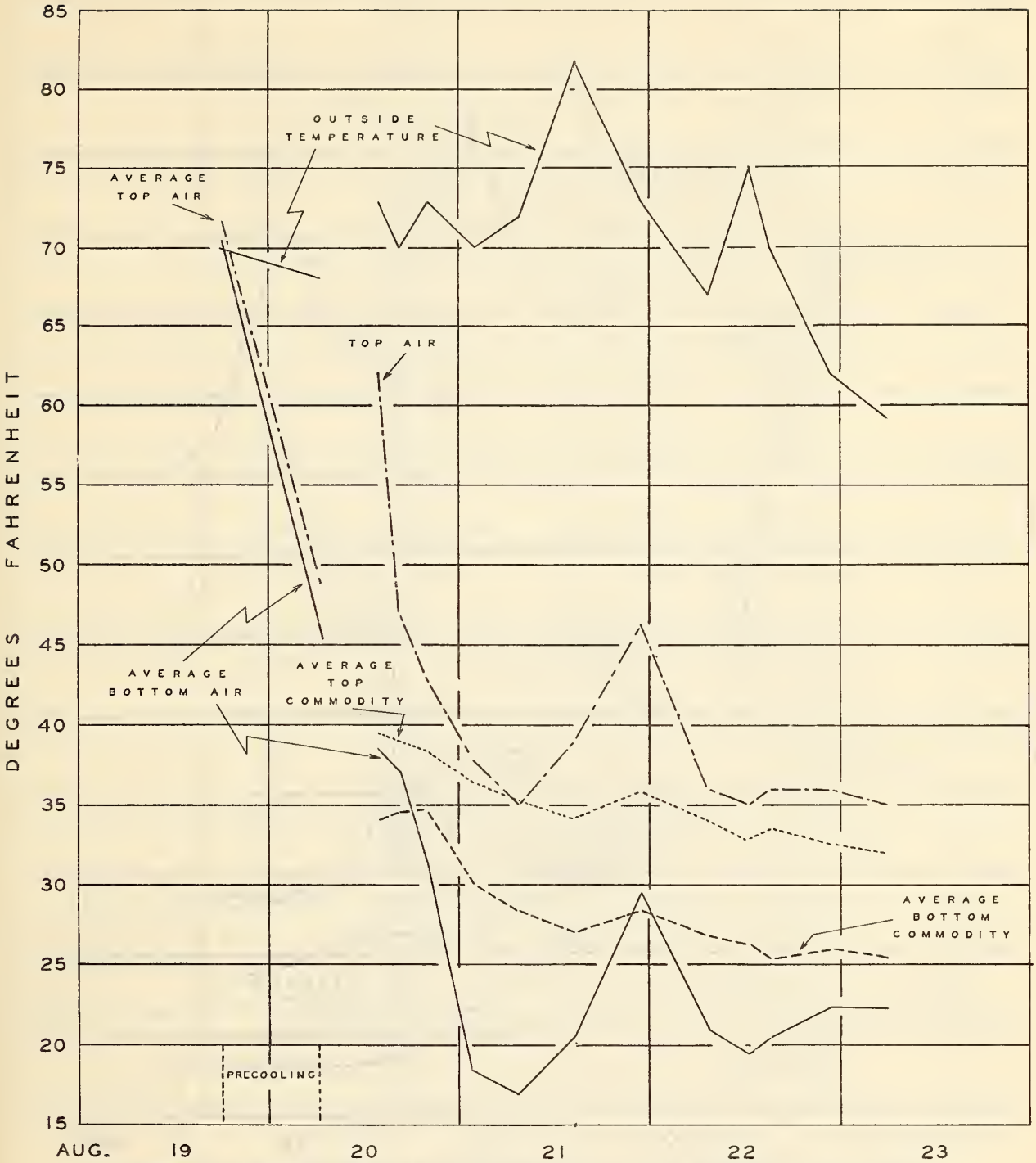


Figure 24.--Precooling and transit temperatures in car S loaded with meat and packinghouse products and shipped from Madison, Wis., to Philadelphia, Pa., August 19-23, 1952.

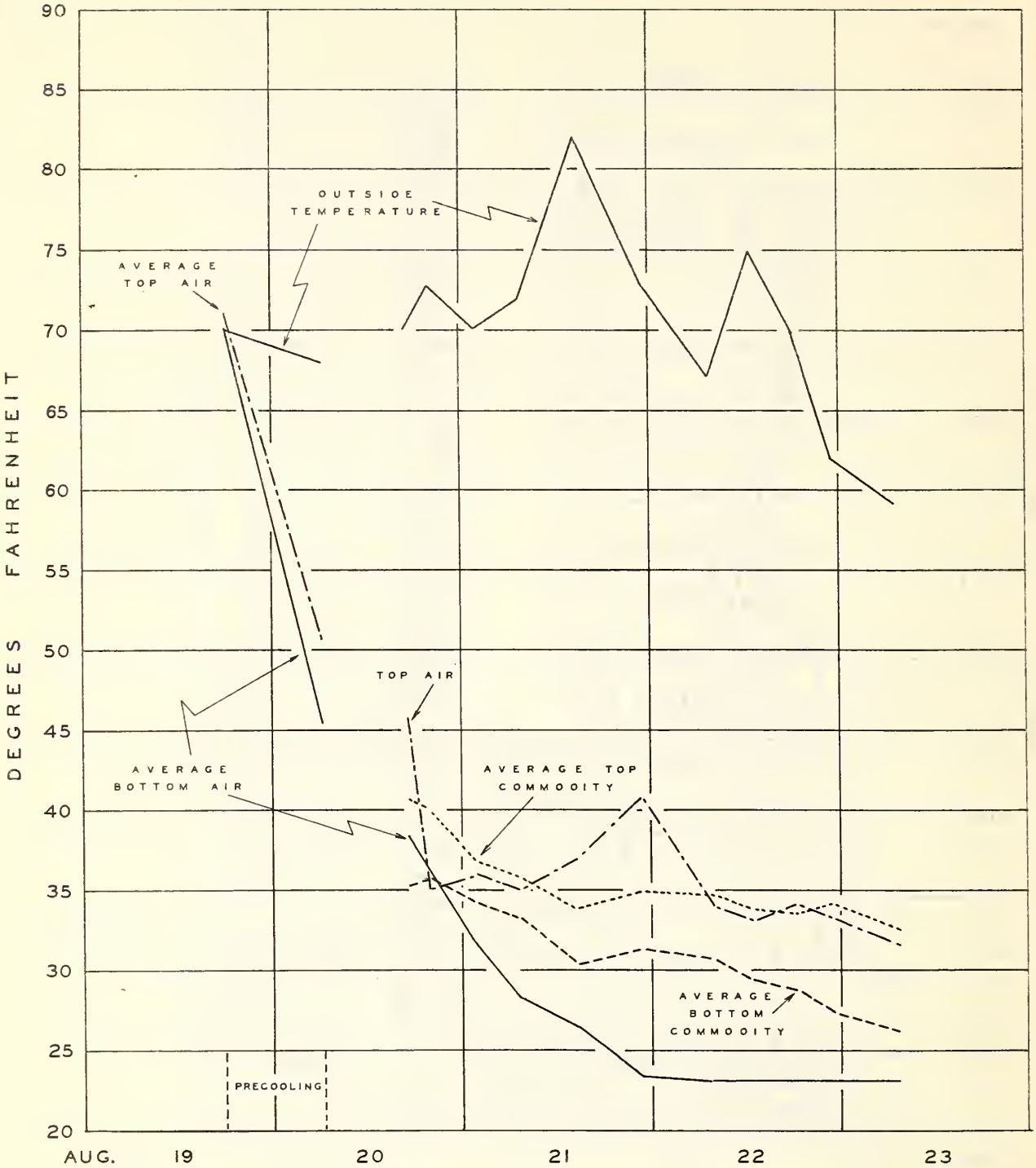


Figure 25.--Precooling and transit temperatures in car T loaded with meat and packinghouse products and shipped from Madison, Wis., to Philadelphia, Pa., August 19-23, 1952.

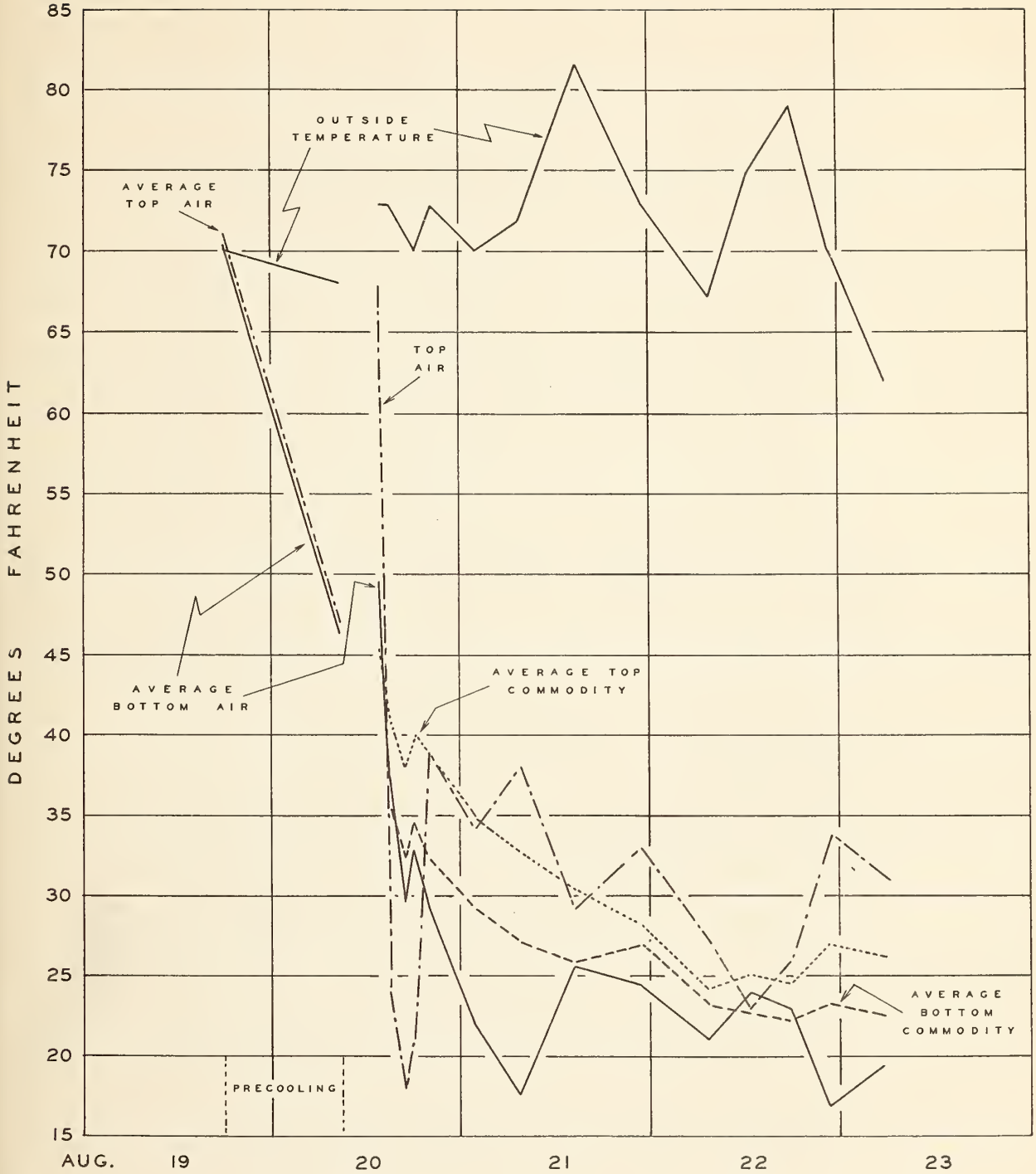


Figure 26.--Precooling and transit temperatures in car U loaded with meat and packinghouse products and shipped from Madison, Wis., to Philadelphia, Pa., August 19-23, 1952.

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